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Feds execute search warrants at Calif. solar firm that got $535M US loan, filed for bankruptcy

View Photo Gallery — Solyndra, a California solar company backed by a half-billion dollars in loan guarantees from the Obama administration, announced it was shutting its doors and laying off 1,100 employees.

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By Associated Press,

FREMONT, Calif. — FBI agents executed search warrants on Thursday at the headquarters of California solar firm Solyndra, which received a $535 million loan from the federal government before filing for bankruptcy last week.

Agents executed multiple search warrants at the company's headquarters in Fremont as part of an investigation with the Department of Energy's Office of Inspector General, according to FBI spokesman Peter Lee. Lee said he could not provide details about the investigation.

Solyndra LLC is a solar-panel manufacturer once touted by President Barack Obama as a beneficiary of his administration's economic

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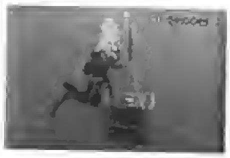

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[NY Times]

by Taboola

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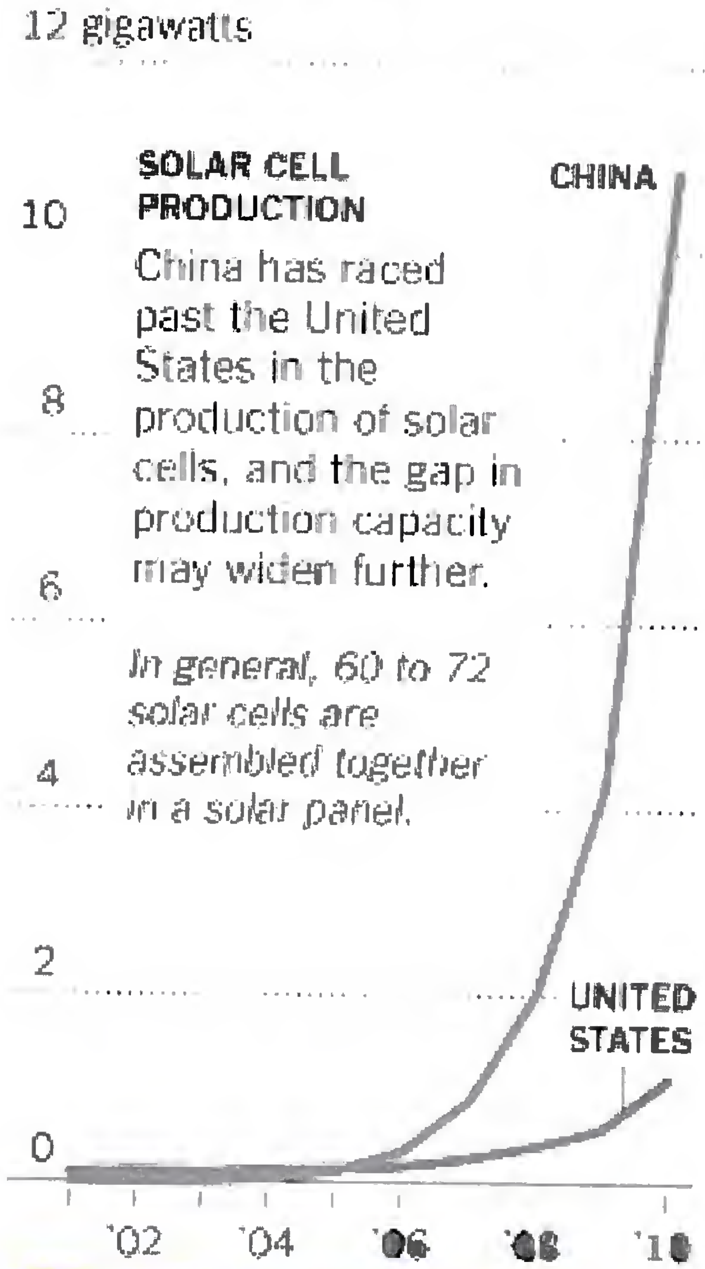

Source: Shayle Kann, GTM Research

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News

PRESS CONTACT

Contact: David Miller, Director, Corporate Communications (510) 440-2979.

Solyndra Suspends Operations to Evaluate Reorganization Options

FREMONT, Calif., August 31, 2011 – Solyndra LLC, American manufacturer of innovative cylindrical solar systems for commercial rooftops today announced th global economic and solar industry market conditions have forced the Company to suspend its manufacturi operations. Solyndra intends to file a petition for relie under Chapter 11 of the U.S. Bankruptcy Code while evaluates options, including a sale of the business ar licensing of its advanced CIGS technology and manufacturing expertise. As a result of the suspensic

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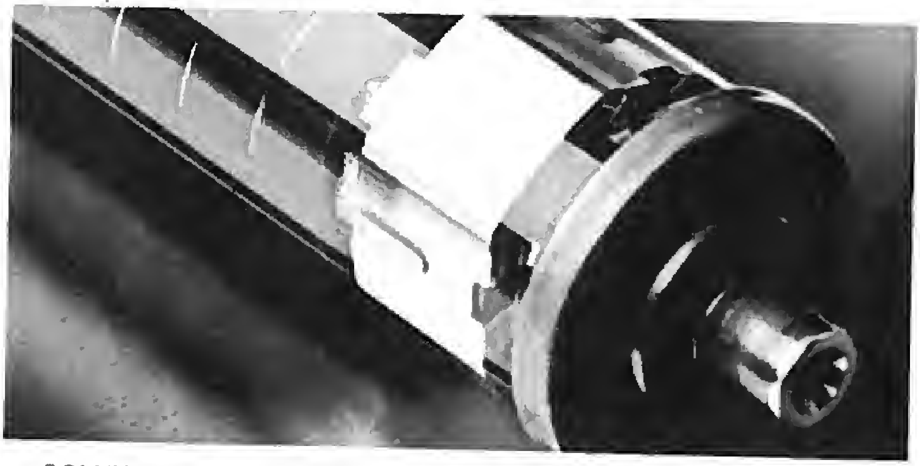

SOLYNDRA SUSPENDS OPERATIONS TO EVALUATE REORGANIZATION OPTIONS

Solyndra Suspends Operations to Evaluate Reorganization Options

August 31, 2011 – Solyndra LLC, the American manufacturer of innovative cylindrical solar systems f commercial rooftops today announced that global economic and solar industry market conditions have forced the Company to suspend its manufacturing operations. Solyndra intends to file a petition for relie under Chapter 11 of the U.S. Bankruptcy Code while evaluates options, including a sale of the business ar licensing of its advanced CIGS technology and

manufacturing expertise. As a result of the suspensic operations approximately 1,100 full-time and temporа employees are being laid off effective immediately.

Despite strong growth in the first half of 2011 and tra in North America with a number of orders for very lar commercial rooftops, Solyndra could not achieve full-scale operations rapidly enough to compete in the ne term with the resources of larger foreign manufacture This competitive challenge was exacerbated by a glo oversupply of solar panels and a severe compressior prices that in part resulted from uncertainty in governmental incentive programs in Europe and the decline in credit markets that finance solar systems.

"We are incredibly proud of our employees, and we w like to thank our investors, channel partners, custome and suppliers, for the years of support that allowed u bring our innovative technology to market. Distributec rooftop solar power makes sense, and our customers clearly recognize the advantages of Solyndra system said Solyndra's president and CEO, Brian Harrison. "Regulatory and policy uncertainties in recent months created significant near-term excess supply and price erosion. Raising incremental capital in this environme was not possible. This was an unexpected outcome a is most unfortunate."

Customers who have implemented Solyndra solution can be assured that their systems will generate economical, clean, solar power for decades.

###

Contact: Dave Miller, Director Corporate Communica
(510) 440-2979.

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Request Sales and Product Information

If you have questions about Solyndra products,
In the U.S: nasales@solyndra.com
In Europe: emeasales@solyndra.com

Press Inquiries

If you would like to inquire about Solyndra for press articles and other media, please e-mail **david.miller@solyndra.com** or call +1.510.440.297

Or to contact a customer service representative by phone, please call or email us at:

Mendelsohn, Jacquelyn - ETA

From: Customer Support [customersupport@solyndra.com]
Sent: Tuesday, September 06, 2011 4:09 PM
To: Mendelsohn, Jacquelyn - ETA
Subject: Automatic reply: Federal Investigation--Trade Adjustment Assistance TA-W-80,410

Thank you for your inquiry. Solyndra announced today in a press release that it has ceased operations and intends to file for Chapter 11 bankruptcy protection. If you need to talk to a sales representative you can send an email to Groupnasales@solyndra.com and someone will get back to you within 24 hours.

Mendelsohn, Jacquelyn - ETA

From: David Miller [david.miller@solyndra.com]
Sent: Friday, September 09, 2011 3:16 PM
To: Mendelsohn, Jacquelyn - ETA
Subject: RE: TAA

Sorry, we've had quite the week here, I'll get to them as quick as possible.

Dave

From: Mendelsohn, Jacquelyn - ETA [mailto:mendelsohn.jacquelyn@dol.gov]
Sent: Friday, September 09, 2011 12:12 PM
To: David Miller
Subject: TAA

Hello David, do you have any questions regarding the forms?

www.doleta.gov/tradeact

Thanks in Advance,
Jacquelyn Mendelsohn
Program Analyst
U.S. Department of Labor
Office of Trade Adjustment Assistance
200 Constitution Ave, N.W. Room N-5428
Washington, DC 20210
Tel: 202-693-3569
Fax: 202-693-3986

Mendelsohn, Jacquelyn - ETA

From: David Miller [david.miller@solyndra.com]
Sent: Tuesday, September 06, 2011 4:56 PM
To: Mendelsohn, Jacquelyn - ETA; Mary Lou Strong
Subject: RE: Trade Adjustment Assistance TA-W-80,410

Jacquelyn,

Thank you for this, we'll get to work on it right away.

Thanks,
Dave

From: Mendelsohn, Jacquelyn - ETA [mailto:mendelsohn.jacquelyn@dol.gov]
Sent: Tuesday, September 06, 2011 1:03 PM
To: David Miller; Mary Lou Strong
Subject: Trade Adjustment Assistance TA-W-80,410
Importance: High

U.S. Department of Labor

Employment and Training Administration
200 Constitution Avenue, N.W.
Washington, D.C. 20210

Use for: ETA-9043a Form, Business Confidential Data Request Article

Tuesday, September 06, 2011

David Miller
Solyndra
47488 Kato Road
Freemont, California 94538

Re: TA-W-80,410, **Solyndra, Freemont, California 94538**, ETA-9043a Form, Business Confidential Data Request Article

Dear **Mr. Miller**:

A petition requesting certification of eligibility to apply for adjustment assistance under the Trade Act of 1974, as amended (Trade Act), 19 USC § 2271, et seq., has been filed with the U.S. Department of Labor (the Department) on behalf of workers of **Solyndra, Freemont, California 94538, (TA-W-80,410) which produce cylindrical solar systems**. In response to this petition, the Department is required to conduct an investigation to determine if foreign trade was a cause of their job losses. For those workers certified as affected by foreign trade, the Trade Act provides a variety of employment services and benefits to help them obtain suitable employment. The benefits are paid from federal funds, not by the business or industry affected. Your assistance in expeditiously completing this form is necessary for the Department to determine whether workers may be eligible for federal benefits.

In order for the Department to meet its responsibility under the Trade Act, your company must

furnish the data listed in the enclosed information request: ETA-9043a Form. Because there is a statutory deadline for determining eligibility, you must submit all data no later than **September 12, 2011**. The requested information is considered vital to the investigation and the Secretary of Labor is authorized to obtain the information by subpoena, if necessary 19 USC § 2321. Should you have any questions about this request or a concern about the compliance date, I can be reached at Mendelsohn.Jacquelyn@dol.gov.

All information submitted under this request will be used to determine whether the criteria for certification of the workers covered by the petition, under 19 USC § 2272, have been satisfied. The Department will protect the confidentiality of the information you provide to the full extent of the law, in accordance with the Trade Secrets Act, 18 USC 1905 and the Freedom of Information Act, 5 USC 552(b) (4), 29 CFR Parts 70 and 90, and Executive Order 12600, dated June 23, 1987 (352 FR 23781, June 25, 1987).

Attached is the Department's information request. Please return the completed data form(s) to me by **email at Mendelsohn.Jacquelyn@dol.gov or by FAX at (202) 693-3986**. The form may also be mailed to: U.S. Department of Labor, ETA/TAA Office, 200 Constitution Ave., N.W., Room N-5428, Washington, D.C. 20210, Attn: **Jacquelyn Mendelsohn**.

Sincerely,

Jacquelyn Mendelsohn

Office of Trade Adjustment Assistance

Attachment

www.doleta.gov/tradeact

Thanks in Advance,

Jacquelyn Mendelsohn
Program Analyst
U.S. Department of Labor
Office of Trade Adjustment Assistance
200 Constitution Ave, N.W. Room N-5428
Washington, DC 20210
Tel: 202-693-3569
Fax: 202-693-3986

Mendelsohn, Jacquelyn - ETA

From: Zuckerman, Lois - SOL
Sent: Friday, September 16, 2011 11:05 AM
To: Mendelsohn, Jacquelyn - ETA
Subject: FW: bankruptcy info

Re:
Solyndra, LLC
47488 Kato Road
Fremont, CA 94538
(Debtor)

For this Debtor, Vin went on PACER to find the status of the Delaware Bankruptcy Court proceeding. Note that there is more than one Solyndra bankruptcy case: 11-12799-MFW and11-12800-MFW. Here's more contact info than you need, but it is all publicly available on PACER.

PLMK if you need more info on the bankruptcy cases.

Lois R. Zuckerman
Assistant Counsel for Employment & Training Advice
Division of Employment and Training Legal Services
Office of the Solicitor
U.S. Department of Labor
200 Constitution Avenue, NW, Suite N2101
direct dial #: 202-693-5736

This message may contain information that is privileged or otherwise exempt from disclosure under applicable law. Do not disclose without consulting the Office of the Solicitor. If you think you received this email in error, please notify the sender immediately.

From: Costantino, Vincent - SOL
Sent: Friday, September 16, 2011 10:49 AM
To: Zuckerman, Lois - SOL
Subject: bankruptcy info

Attorneys

Mario Aieta
Satterlee Stephens Burke & Burke
230 Park Ave.
Suite 1130
New York, NY 10169
212-818-9200
212-818-9606 (fax)
maieta@ssbb.com
Assigned: 09/14/2011

representing **Speedmark Transportation, Inc.** *(Interested Party)*

Sean Matthew Beach
Young, Conaway, Stargatt & Taylor
The Brandywine Building, 17th Floor
1000 West Street
PO Box 391
Wilmington, DE 19899
302-571-6600
302-576-3281 (fax)
bankfilings@ycst.com
Assigned: 09/07/2011

representing **Argonaut Solar LLC** *(Interested Party)*

Argonaut Ventures I, L.L.C. *(Interested Party)*

Solyndra Solar II LLC *(Interested Party)*

Solyndra Solar LLC *(Interested Party)*

Karen C Bifferato
Connolly, Bove, Lodge & Hutz
The Nemours Building
1007 North Orange Street
P.O. Box 2207
Wilmington, DE 19899
usa
302-888-6221

representing **Global Kato HG, LLC** *(Creditor)*

302-658-0380 (fax)
kbifferato@cblh.com
Assigned: 09/12/2011

Pamela A. Bosswick Satterlee Stephens Burke & Burke LLP 230 Park Avenue New York, NY 10169 212-818-9200 212-818-9606 (fax) pbosswick@ssbb.com *Assigned: 09/14/2011*	representing	**Speedmark Transportation, Inc.** *(Interested Party)*
Shawn M. Christianson Buchalter Nemer, P.C. 333 Market Street, 25th Floor San Francisco, CA 94105-2130 (415)227-0900 (415)227-0770 (fax) schristianson@buchalter.com *Assigned: 09/14/2011*	representing	**Oracle America, Inc** Buchalter Nemer c/o Shawn M. Christianson 333 Market St., 25th Floor San Francisco, Ca 94105 415-227-0770 (fax) schristianson@buchalter.com *(Creditor)*
Joshua Fried Pachulski Stang Ziehl & Jones LLP 150 California Street, 15th Floor San Francisco, CA 94111 212-263-7000 212-263-7010 (fax) *Assigned: 09/07/2011*	representing	**Solyndra, LLC** 47488 Kato Road Fremont, CA 94538 *(Debtor)*
Gerald H. Gline Cole Schotz Meisel Forman & Leonard 25 Main Street P.O. Box 800 Hackensack, NJ 07601 usa 201-489-3000 201-489-1536 (fax) ggline@coleschotz.com *Assigned: 09/09/2011*	representing	**Menlo Logistics, Inc.** *(Interested Party)*
Lawrence Stephen Glosser Ahlers & Cressman PLLC 999 3rd Ave Suite 3800 Seattle, WA 98104 206-287-9900 206-287-9902 (fax) lglosser@ac-lawyers.com *Assigned: 09/13/2011*	representing	**McKinstry Essention Inc.** c/o Lawrence S. Glosser Ahlers & Cressman PLLC 999 Third Avenue Suite 3800 Seattle, WA 98104 *(Creditor)*
Debra Grassgreen Pachulski Stang Ziehl & Jones LLP 150 California Street, 15th Floor San Francisco, CA 94111 212-263-7000 212-263-7010 (fax) dgrassgreen@pszjlaw.com *Assigned: 09/07/2011*	representing	**Solyndra, LLC** 47488 Kato Road Fremont, CA 94538 *(Debtor)*
Michael S. Greger Allen Matkins Gamble Leck & Mallory LLP 1900 Main Street 5th Floor Irvine, CA 92614-7321 949-553-1313 mgreger@allenmatkins.com *Assigned: 09/14/2011*	representing	**Global Kato HG, LLC** *(Creditor)*
Bruce Grohsgal Pachulski, Stang, Ziehl, Young, Jones 919 N. Market Street 16th Floor Wilmington, DE 19801 302-778-6403 302-652-4400 (fax) bgrohsgal@pszyj.com *Assigned: 09/06/2011*	representing	**Solyndra, LLC** 47488 Kato Road Fremont, CA 94538 *(Debtor)*

Bruce Grohsgal Pachulski, Stang, Ziehl Young & Jones 919 N. Market Street 16th Floor Wilmington, DE 19899-8705 302-778-6403 302-652-4400 (fax) bgrohsgal@pszyj.com *Assigned: 09/06/2011*	representing	**Solyndra, LLC** 47488 Kato Road Fremont, CA 94538 *(Debtor)*
Lee Harrington Nixon Peabody LLP 100 Summer Street Boston, MA 02110 (617) 345-6016 (866) 741-0618 (fax) lharrington@nixonpeabody.com *Assigned: 09/14/2011*	representing	**Lintelle Engineering, Inc.** c/o Lee Harrington Nixon Peabody LLP 100 Summer Street Boston, MA 02110 617 345 6016 617 345-1200 (fax) lharrington@nixonpeabody.com *(Creditor)*
Matthew K. Kelsey Gibson, Dunn & Crutcher LLP 200 Park Avenue New York, NY 10166 212-351-4000 212-351-4035 (fax) MKelsey@gibsondunn.com *Assigned: 09/09/2011*	representing	**Argonaut Ventures I, L.L.C.** *(Interested Party)*
Maxim B. Litvak Pachulski Stang Ziehl & Jones LLP 150 California Street 15th Floor San Francisco, CA 94111 *Assigned: 09/07/2011*	representing	**Solyndra, LLC** 47488 Kato Road Fremont, CA 94538 *(Debtor)*
Robert Michael Marshall Robert M. Marshall, LLC 155 Willowbrook Blvd Wayne, NJ 07470 973-812-4499 973-812-4489 (fax) rmarshall@mqlaw.net *Assigned: 09/13/2011*	representing	**Yusen Logistics (Americas), Inc.** *(Creditor)*
Dennis A. Meloro Greenberg Traurig The Nemours Building 1007 North Orange Street Suite 1200 Wilmington, DE 19801 302-661-7000 302-661-7360 (fax) bankruptcydel@gtlaw.com *Assigned: 09/08/2011*	representing	**Satcon Technology Corporation** bankruptcydel@gtlaw.com *(Interested Party)*
Dennis D. Miller Stein & Lubin LLP 600 Montgomery Street 14th Floor San Francisco, CA 94111 415-981-0550 415-981-4343 (fax) dmiller@steinlubin.com *Assigned: 09/14/2011*	representing	**iStar CTL I, L.P.** Dennis D. Miller Stein & Lubin LLP 600 Montgomery Street, 14th Fl. San Francisco, CA 94111 (415) 981-0550 (415) 981-4343 (fax) dmiller@steinlubin.com *(Creditor)*
Lucian Borders Murley Saul Ewing LLP 222 Delaware Avenue Suite 1200 P.O. Box 1266 Wilmington, DE 19899 302-421-6898 302-421-5864 (fax) *Assigned: 09/08/2011*	representing	**Carlton-Bates Company, a division of WESCO Distribution, Inc.** *(Creditor)*
Norman L. Pernick Cole, Schotz, Meisel, Forman & Leonard,		

500 Delaware Avenue,Suite 1410 Wilmington, DE 19801 302-652-3131 302-652-3117 (fax) bankruptcy@coleschotz.com *Assigned: 09/07/2011*	representing	**Menlo Logistics, Inc.** *(Interested Party)*
Marc J. Phillips Connolly Bove Lodge & Hutz LLP The Nemours Building 1007 North Orange Street Wilmington, DE 19801 302-658-9141 302-658-0380 (fax) mphillips@cblh.com *Assigned: 09/14/2011*	representing	**Global Kato HG, LLC** *(Creditor)*
Robert F. Poppiti, Jr. Young, Conaway, Stargatt & Taylor, LLP The Brandywine Building 1000 West Street 17th Floor Wilmington, DE 19801 302-571-6600 bankfilings@ycst.com *Assigned: 09/07/2011*	representing	**Argonaut Solar LLC** *(Interested Party)*
		Argonaut Ventures I, L.L.C. *(Interested Party)*
		Solyndra Solar II LLC *(Interested Party)*
		Solyndra Solar LLC *(Interested Party)*
Michael A. Rosenthal Gibson Dunn & Crutcher LLP 200 Park Avenue 47th Floor New York, NY 10166 212-351-4000 212-351-4035 (fax) mrosenthal@gibsondunn.com *Assigned: 09/09/2011*	representing	**Argonaut Ventures I, L.L.C.** *(Interested Party)*
Bayard J. Snyder Snyder & Associates, PA 300 Delaware Avenue, Suite 1014 P.O. Box 90 Wilmington, DE 19801 302 657-8300 302 657-8301 (fax) snyder90bkrt@aol.com *Assigned: 09/09/2011*	representing	**Yusen Logistics (Americas), Inc.** *(Creditor)*
John Stemplewicz U. S. Dept. of Justice P. O. Box 875 Ben Franklin Station Washington, DC 20044 (202) 307-1104 (202) 305-4933 (fax) john.stemplewicz@usdoj.gov *Assigned: 09/06/2011*	representing	**UNITED STATES OF AMERICA** United States Department of Justice P.O. Box 875 Ben Franklin Station Washington, DC 20044-0875 *(Interested Party)*
Matthew J. Troy U.S. Department of Justice Civil Division P.O. Box 875 Ben Franklin Station Washington, DC 20044-0875 usa 202-514-9038 202-307-0494 (fax) matthew.troy@usdoj.gov *Assigned: 09/06/2011*	representing	**UNITED STATES OF AMERICA** Department of Justice, Civil Division POB 875 Ben Franklin Station Washington, DC 20044-0875 *(Creditor)*
Assigned: 09/06/2011		**UNITED STATES OF AMERICA** United States Department of Justice

	representing	P.O. Box 875 Ben Franklin Station Washington, DC 20044-0875 *(Interested Party)*
J. Eric Wise Gibson, Dunn & Crutcher LLP 200 Park Avenue New York, NY 10166-0193 212-351-4000 212-351-4035 (fax) ewise@gibsondunn.com *Assigned: 09/09/2011*	representing	**Argonaut Ventures I, L.L.C.** *(Interested Party)*

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U.S. Bankruptcy Court
District of Delaware (Delaware)
Bankruptcy Petition #: 11-12800-MFW

Assigned to: Mary F. Walrath
Chapter 11
Voluntary
Asset

Date filed: 09/06/2011

Show Associated Cases

Debtor **360 Degree Solar Holdings, Inc.** 47488 Kato Road Fremont, CA 94538 Tax ID / EIN: 41-2175583 ***fka*** **Solyndra, Inc.** ***fka*** **Gronet Technologies, Inc.**	represented by	**Bruce Grohsgal** Pachulski, Stang, Ziehl Young & Jones 919 N. Market Street 16th Floor Wilmington, DE 19899-8705 302-778-6403 Fax : 302-652-4400 Email: bgrohsgal@pszyj.com
U.S. Trustee **United States Trustee** 844 King Street, Room 2207 Lockbox #35 Wilmington, DE 19899-0035 302-573-6491		

Filing Date	#	Docket Text
09/06/2011	1	Chapter 11 Voluntary Petition *of 360 Degree Solar Holdings, Inc.*. Fee Amount $1039. Filed by 360 Degree Solar Holdings, Inc.. (Attachments: # 1 Board Resolutions# 2 Consolidated List of Creditors Holding Top 35 Unsecured Claims with Certification# 3 List of Equity Holders with Certification# 4 Corporate Ownership Statement) (Grohsgal, Bruce) (Entered: 09/06/2011)
09/06/2011	2	Exhibit(s) *[Creditor Matrix with Certification]* (related document(s) 1) Filed by 360 Degree Solar Holdings, Inc.. (Grohsgal, Bruce) (Entered: 09/06/2011)
09/06/2011		Judge Mary F. Walrath added to case (Manley, Stacey) (Entered: 09/06/2011)
		Receipt of filing fee for Voluntary Petition (Chapter 11)(11-12800) [misc,volp11a] (1039.00). Receipt Number 5469740,

09/07/2011	3	amount $1039.00. (U.S. Treasury) (Entered: 09/07/2011)
09/07/2011	4	Order Authorizing Joint Administration. An Order Has Been Entered in This Case Directing the Joint Administration of the Chapter 11 case Listed Below. The Docket in case No. 11-12799(MFW) Should be Consulted For All Matters Affecting This Case. The Following Chapter 11 Cases Are Jointly Administered Pursuant to the Joint Administration Order: Solyndra LLC Case No 11-12799(MFW) and 360 Degree Solar Holding, Inc. Case No. 11-12800. Signed on 9/7/2011. (SLF) (Entered: 09/07/2011)

PACER Service Center

Transaction Receipt

09/16/2011 10:47:04

PACER Login:	ud0460	**Client Code:**	dol
Description:	Docket Report	**Search Criteria:**	11-12800-MFW Fil or Ent: filed From: 7/18/2011 To: 9/16/2011 Doc From: 0 Doc To: 99999999 Term: included Format: html
Billable Pages:	1	**Cost:**	0.08

Vincent C. Costantino
Assistant Counsel for Litigation
Senior Trial Attorney
Employment and Training Legal Services
Office of the Solicitor
U.S. Department of Labor
(202) 693-5717
(202) 693-5732 (fax)

U.S. Solar Energy Trade Assessment 2010:

Trade Flows and Domestic Content for Solar Energy-Related Goods and Services in the United States

A GTM Research Study

Prepared for Solar Energy Industries Association * November 2010

TABLE OF CONTENTS

LIST OF FIGURES

1 EXECUTIVE SUMMARY

This study is a comprehensive analysis of trade flows and domestic value creation in the U.S. solar energy industry based on data from the calendar year 2009. Many sources of data and analysis focusing on solar trade balance issues exist. To date, however, most of these efforts have taken a fairly simplistic view of solar products. Most focus exclusively on individual product components, such as solar modules, analyzing what proportion of those components are manufactured domestically. In contrast to existing research, this study:

- Captures critical elements of the solar value chain such as installation labor, legal costs, and other "soft costs", the value of which accrues directly to the U.S.
- Analyzes unique trade flows of components of a solar installation, such as polysilicon, that are omitted in other analyses
- Examines, in the case of photovoltaic modules, not just the location of final assembly but also production locations for earlier steps in the value chain.
- Examines all mainstream solar technologies types individually and aggregated – photovoltaics (PV), concentrating solar power (CSP), and solar heating and cooling (SHC).

A significant portion of the revenue generated by solar projects resides beyond the physical components – as site preparation, installation labor, permitting, financing and other soft costs comprise nearly 50% of the total cost. Accordingly, when evaluating solar installations this study focuses on the percent of "total value created" in the U.S., rather than just the components that would figure into a "domestic content" calculation.

This study seeks to answer two fundamental questions:

- What percentage of the value in U.S. solar installations was created domestically in 2009?
- What was the value of solar products that were imported into, and exported from, the United States in 2009?

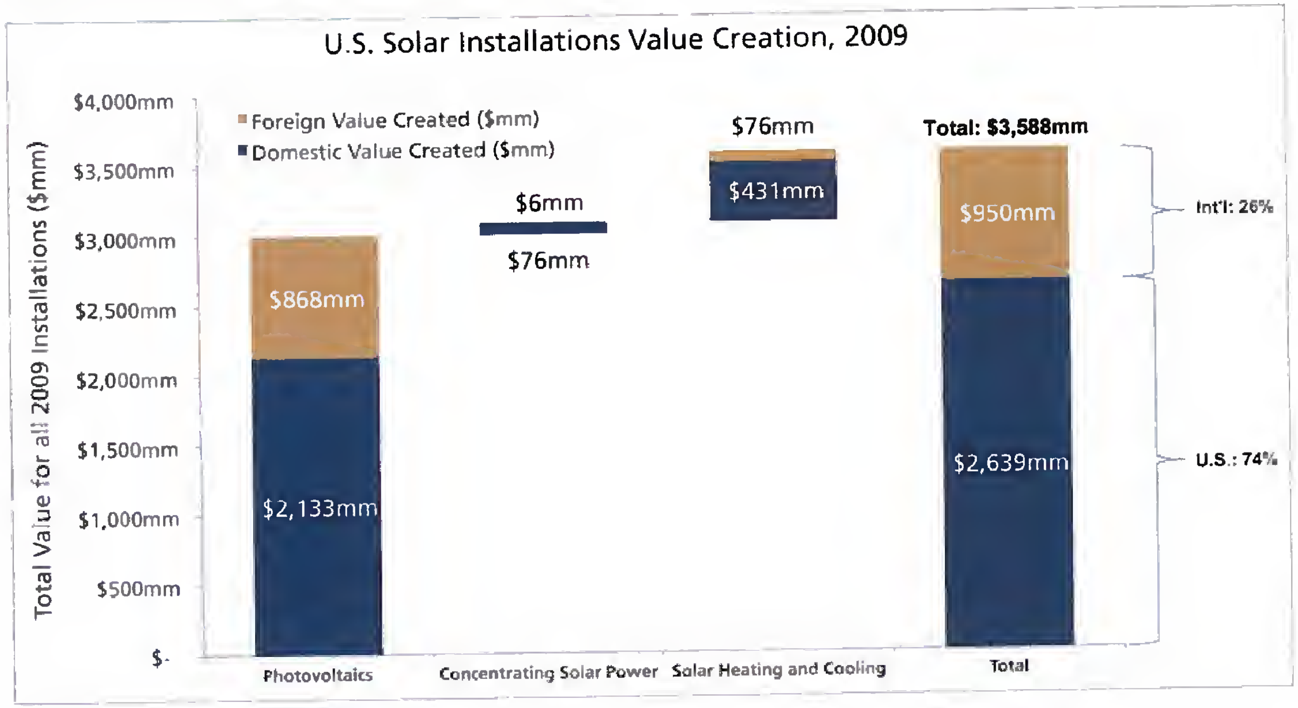
1.1 Key Findings: Solar Energy

- The U.S. is a significant net exporter of solar energy products with total **net exports of $723 million** in 2009.
- The largest solar energy product export is **polysilicon,** the feedstock for crystalline silicon photovoltaics, of which the U.S. exported $1.1 billion in 2009.
- **2009 U.S. solar energy installations created a combined $3.6 billion in direct value, of which $2.6 billion (74%) accrued in the U.S.**
  - 81% ($2.1 billion) of the domestic value created by solar in the U.S. came from the PV sector
  - 16% ($431 million) came from the SHC sector
  - 3% ($76 million) came from the CSP sector

Figure 1-1: Solar Industry Trade Flows, 2009

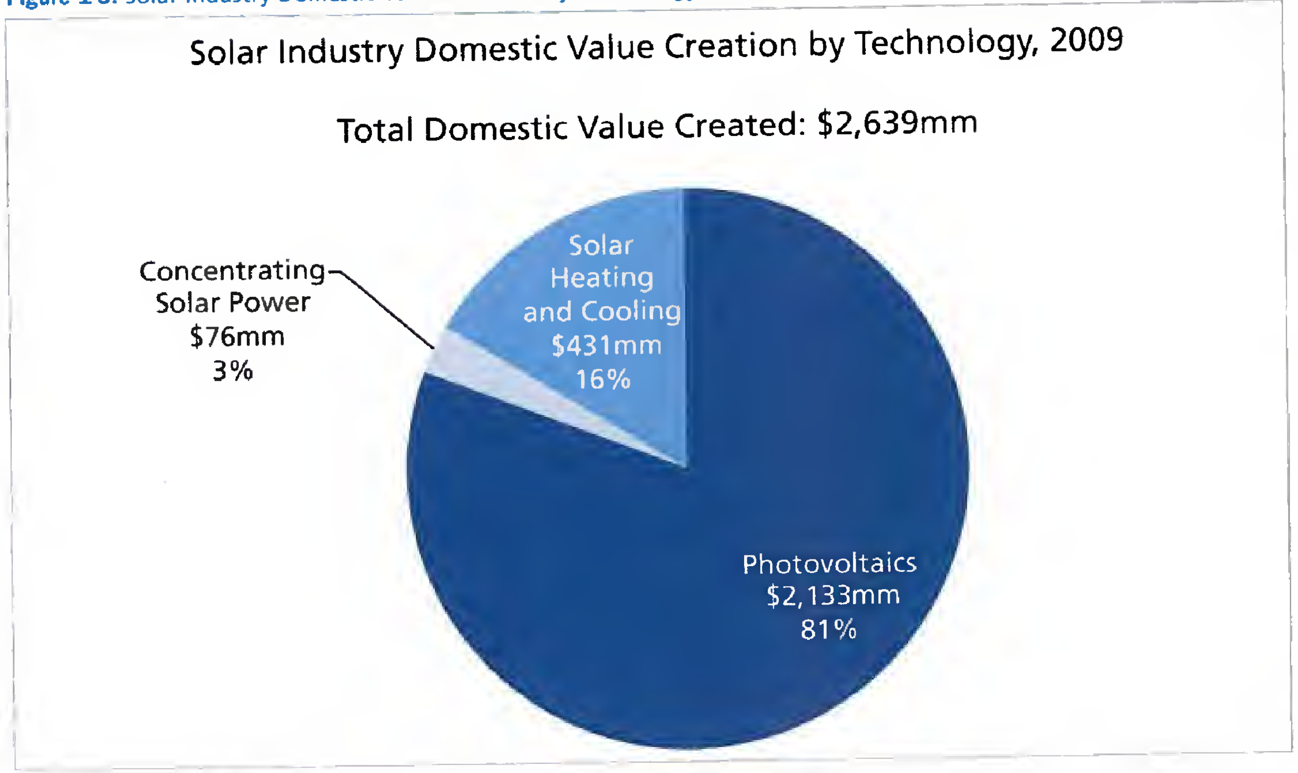
Source: GTM Research, U.S. International Trade Commission

Figure 1-2: U.S. Solar Installations Value Creation, 2009



Source: GTM Research

Figure 1-3: Solar Industry Domestic Value Creation by Technology, 2009



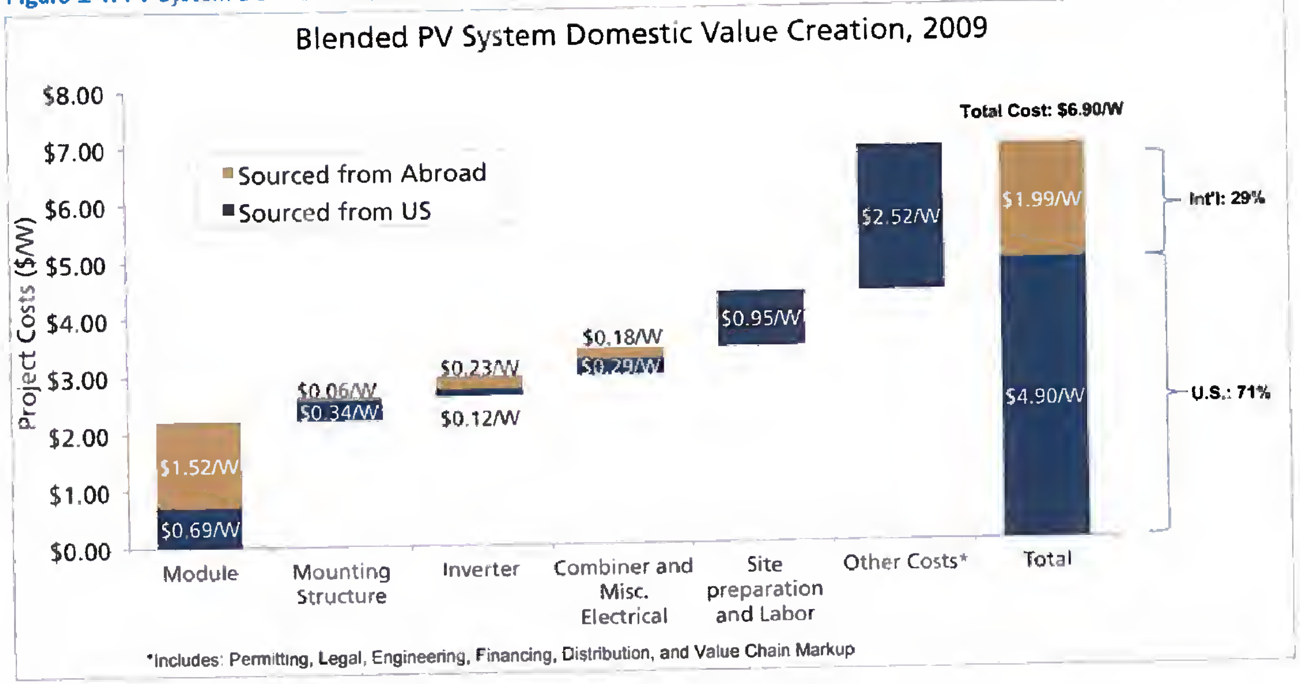
Source: GTM Research

1.2 Photovoltaics (PV)

- 71% of total PV system value was created domestically in 2009. The domestic value was primarily created in the areas of module manufacturing, site preparation, labor, soft costs, and value chain markup for the module distributor and system installer.

- 31% of the value of PV modules deployed in U.S. installations in 2009 was created domestically, while the remaining 69% came from foreign sources. The domestic value was primarily created in the areas of polysilicon production and module assembly for crystalline silicon modules, and capital equipment, glass manufacturing, labor, and value chain markup for thin film modules. On a technology and application-blended basis, modules accounted for 32% of the total representative system cost.

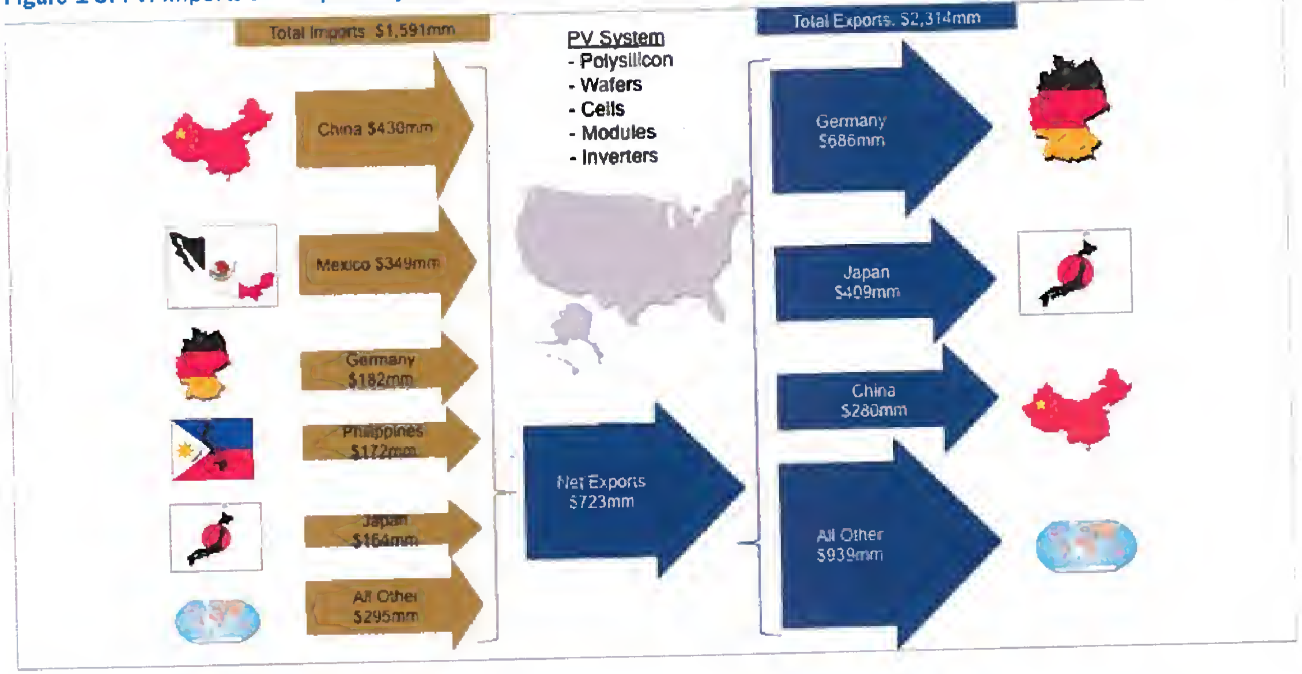
Figure 1-4: PV System Domestic Value Creation, 2009



Source: GTM Research

- U.S. PV-related imports in 2009 totaled $1.6 billion while exports totaled $2.3 billion, making the U.S. a net exporter of PV goods by $723 million. Key export goods included polysilicon and modules, while modules and inverters were the most prominent imported goods. China and Mexico were the locations that contributed the most to imports, while Germany, Japan, and China were the most prominent export destinations.

Figure 1-5: PV: Imports and Exports by Source/Destination, 2009



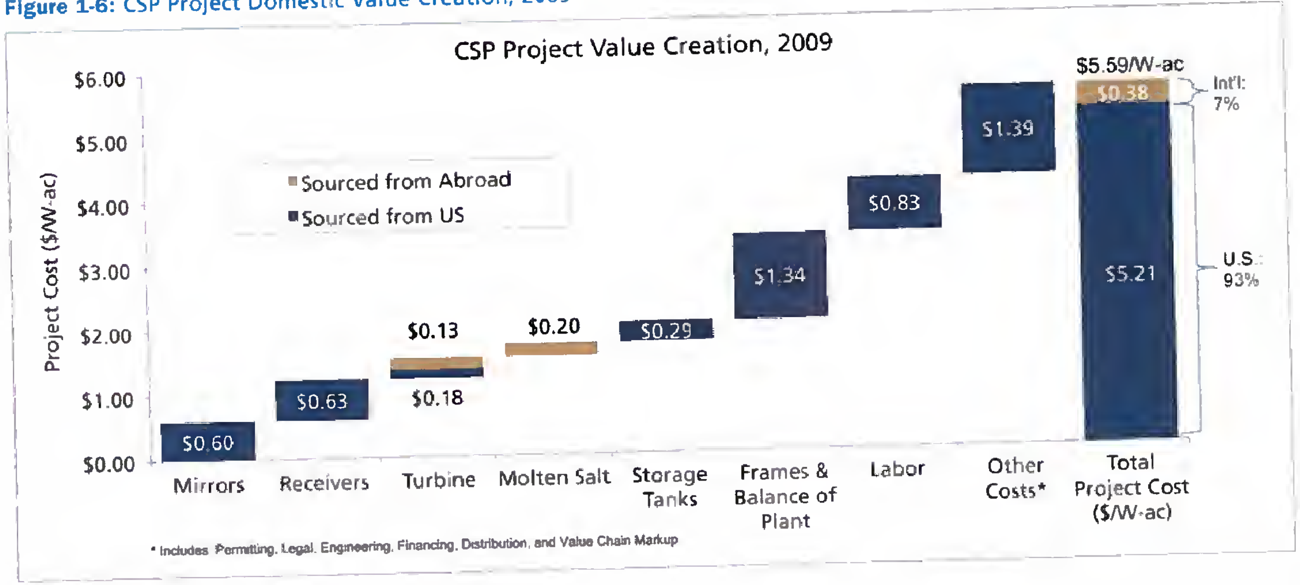
Source: GTM Research

1.3 Concentrating Solar Power (CSP)

- 93% of the total value of 2009 CSP installations was created domestically. Materials sourced from other countries were molten salt (used for thermal storage), and turbines.
- U.S. imports of CSP-related goods totaled $3.8 million, coming from Germany. The U.S. did not export any CSP-related goods in 2009 in significant quantities. Looking forward, trade flows for CSP should remain relatively small, as many of the components are low value per pound commodities (i.e. steel, concrete, mirrors), where the economics favor domestic sourcing to avoid transport costs.

- Note that data for CSP installations in 2009 is limited as there were only two commercial installations in the U.S. in 2009.

Figure 1-6: CSP Project Domestic Value Creation, 2009

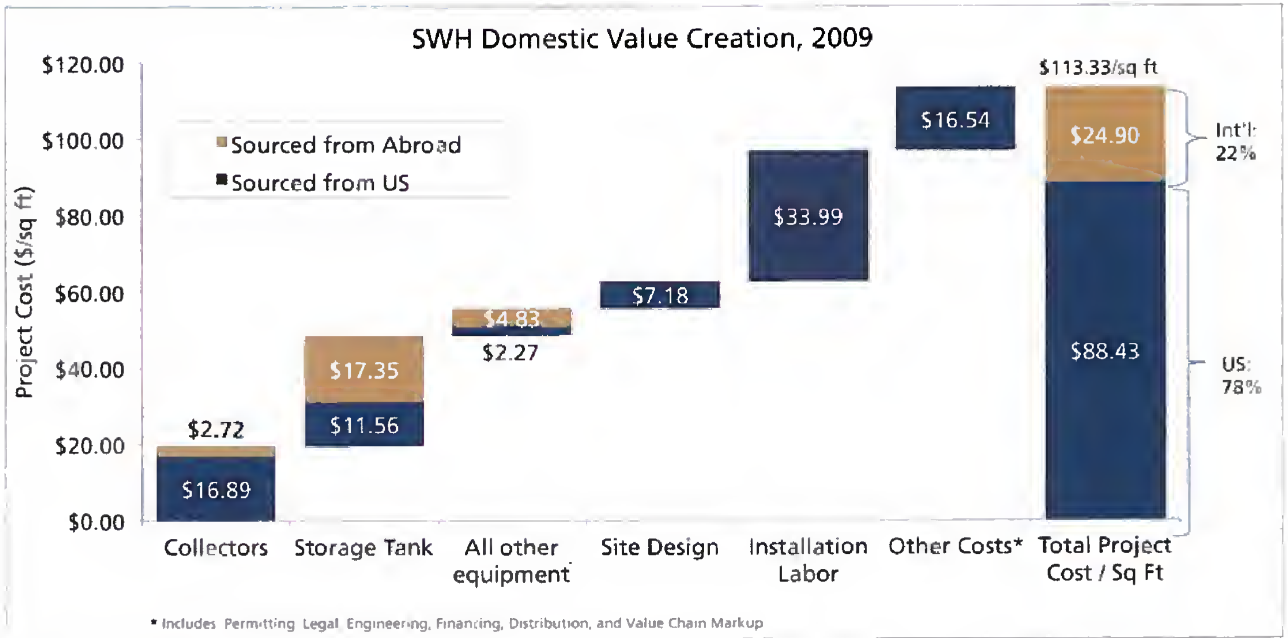


Source: GTM Research

1.4 Solar Heating and Cooling (SHC)

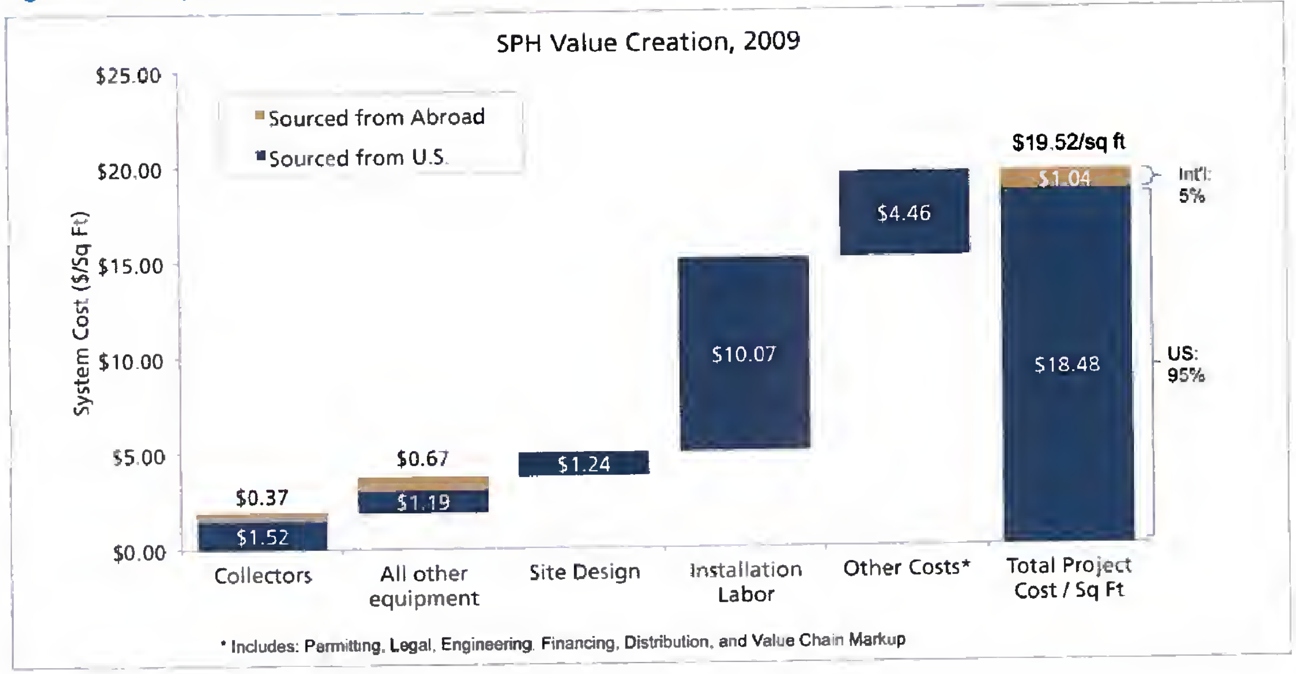
- For solar water heating (SWH) systems, 78% of the total value of 2009 installations was sourced domestically. Storage tanks represented the largest portion of equipment obtained from foreign sources.
- For solar pool heating (SPH) systems, 95% of the total value of 2009 installations was sourced domestically. The 5% of value sourced from abroad was primarily due to Israeli-made collectors.
- Imports of SWH and SPH collectors in 2009 totaled $11 million, compared to exports of $16 million; this made the U.S. a net exporter of SWH and SPH products by $5 million. China was the most prominent import location, while Mexico contributed the most to SWH and SPH exports.

Figure 1-7: SWH System Domestic Value Creation, 2009



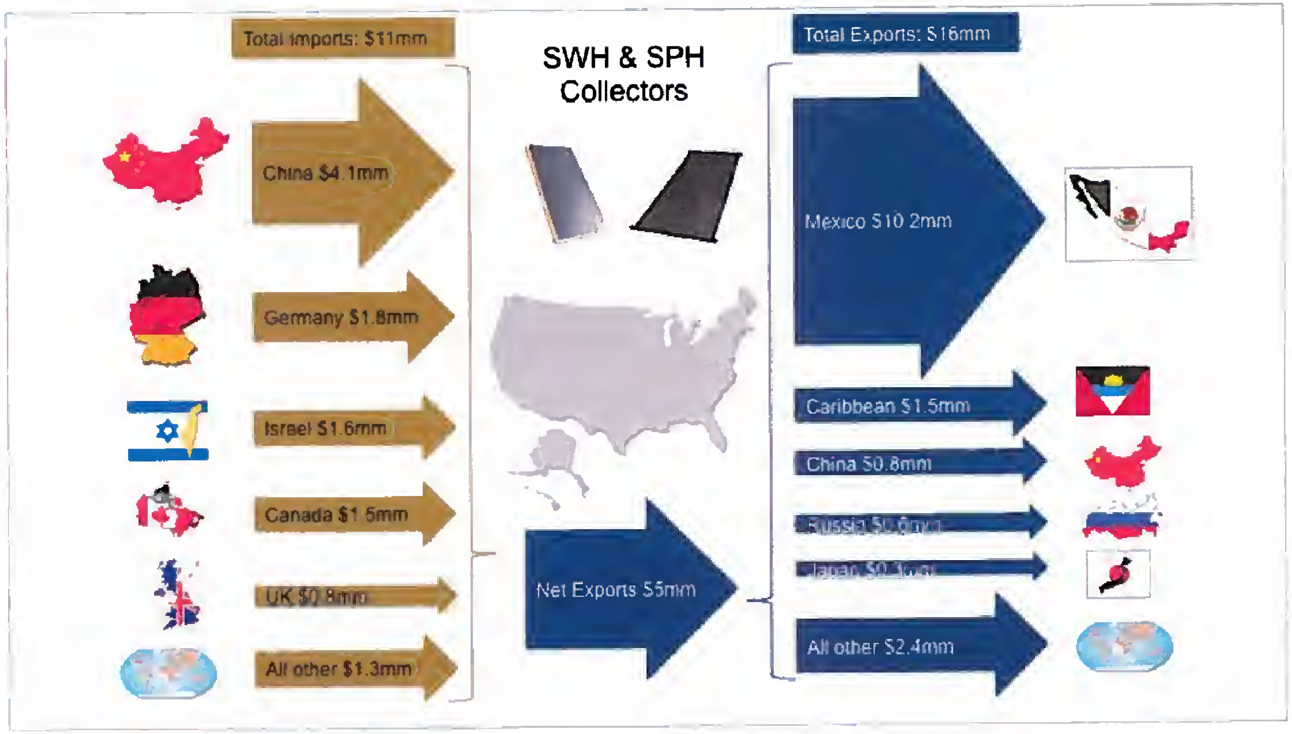
Source: GTM Research

Figure 1-8: SPH System Domestic Value Creation, 2009



Source: GTM Research

Figure 1-9: SWH and SPH Collectors: Imports and Exports by Source/Destination, 2009



Source: GTM Research

2 PHOTOVOLTAICS (PV)

The term photovoltaic (PV) refers to materials that convert light energy—most commonly from the sun—into electrical energy; in these materials, light (photons) striking the surface of a suitable semiconducting material creates a voltage that can be harnessed to create electricity. Conventional PV technologies are primarily differentiated based on the nature of the absorber material that is responsible for converting light into electricity and are typically categorized as:

a. Crystalline silicon

b. Thin films

Other materials exist but have not gained widespread commercial acceptance.

2.1 Domestic Value Created

A total of 435 megawatts (MW) of grid-interactive PV systems were installed in the U.S. in 2009 at a capacity-weighted average price of $6.90/W, indicating a total value of $3 billion for the U.S. solar PV market. Driven by the Federal Investment Tax Credit (ITC), the Section 1603 Treasury Grant in lieu of the ITC and a variety of state-level incentives, 2009 represented 55% demand growth over 2008. As indicated earlier, the key question is how much of this value was created domestically versus sourced from abroad.

To determine the value created domestically, the cost structure of a PV system representative of all U.S. grid-interactive systems installed in 2009 was estimated. Since the two prominent PV technologies (i.e. crystalline silicon and thin film) have markedly different system cost structures, these were estimated separately and then blended together based on the market share of these two technologies in 2009. The primary cost structure elements for a finished system are the following:

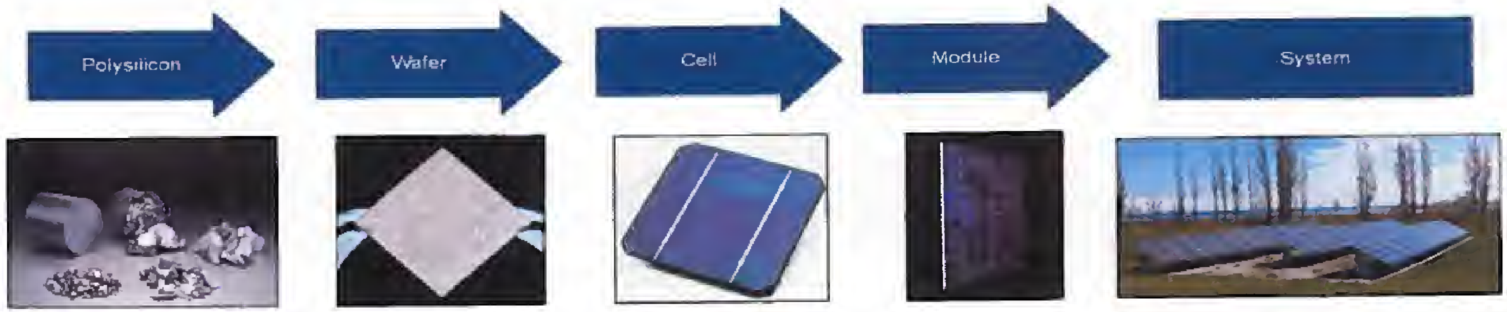
- Module
- Inverter
- Mounting Structure
- Combiner Box and Misc. Electrical Materials
- Site Preparation, Labor, Soft Costs and Value Chain Markup

2.2 Crystalline Silicon PV Modules

Crystalline silicon, or c-Si, is the most commonly used PV technology in the world today, owing to a mature process technology that utilizes the accumulated knowledge base of the semiconductor industry. As shown below, the crystalline silicon PV value chain consists of the following steps:

a. Polysilicon production
b. Ingot/Wafer production
c. Cell production
d. Module assembly

An illustration of the value chain for crystalline silicon PV is provided below.



Source: Hemlock Semiconductor, Schott Solar, PV-Tech, Suntech Power Holdings, National Park Service

Each of these steps is a separate manufacturing process and requires a different set of manufacturing equipment, and individual manufacturing facilities can exist for each. Hence, they are considered independently in terms of their contribution to the overall cost of the PV system and the percentage of value created domestically.

2.2.1 Polysilicon Production

Polycrystalline silicon, commonly known as polysilicon, is the primary raw material for the manufacturing of crystalline silicon PV modules, since it is silicon (with impurities introduced into it) that converts sunlight into electricity. Polysilicon is also used as feedstock for the production of wafers in the semiconductor industry, which are used in the fabrication of integrated circuits and other microdevices.

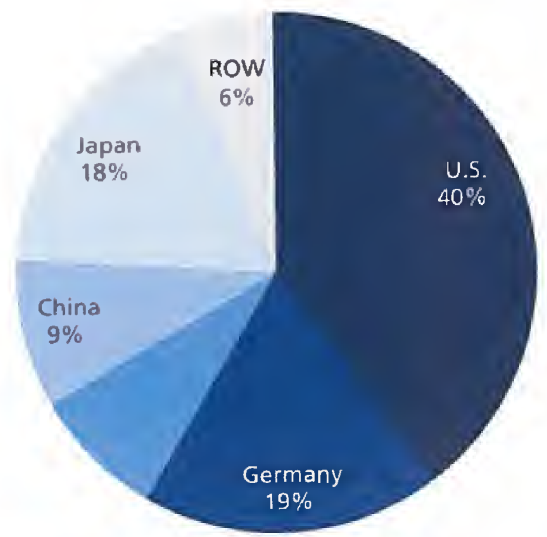
Generally, polysilicon production begins with the conversion of metallurgical-grade silicon (already 99 percent pure) to Trichlorosilane (TCS) or silane in gaseous form. This is then either passed over polycrystalline silicon rods of high purity at 1150 °C (the Siemens process), or passed at extremely high velocities through a chamber containing polysilicon granules (known as the fluidized bed reactor, or FBR process). The end result is extremely high purity polysilicon (at least 99.9999%, or "6N" purity), suitable for use in the PV industry.


Source: Hemlock Semiconductor

Roughly 90% of the polysilicon produced prior to 2000 was used for semiconductor wafers, and the PV industry obtained its polysilicon from the small amount of feedstock not consumed by the semiconductor industry. However, as PV cell production (specifically crystalline silicon PV) exploded in the 2000s (from only 360 MW in 2001 to 3,344 MW in 2007), cell manufacturers began to consume as much polysilicon as chip manufacturers. By 2006, PV consumed more than 50% of polysilicon produced, and this figure is estimated to have increased to over 80% in 2009.

The percentage of value created domestically by polysilicon in a U.S.-installed system was estimated based on U.S. share of global polysilicon production. Global polysilicon production in 2009 amounted to 78,595 metric tons (MT), where 1 metric ton equals 1.000 kilograms. Of this quantity, 31,348 MT, or 40%, came from the U.S. Only three facilities were responsible for this production volume, namely REC's two plants in Washington and Hemlock Semiconductor's facility in Michigan.

Figure 2-1: Global PV Polysilicon Market Share, 2009



Source: GTM Research

Source: Schott Solar

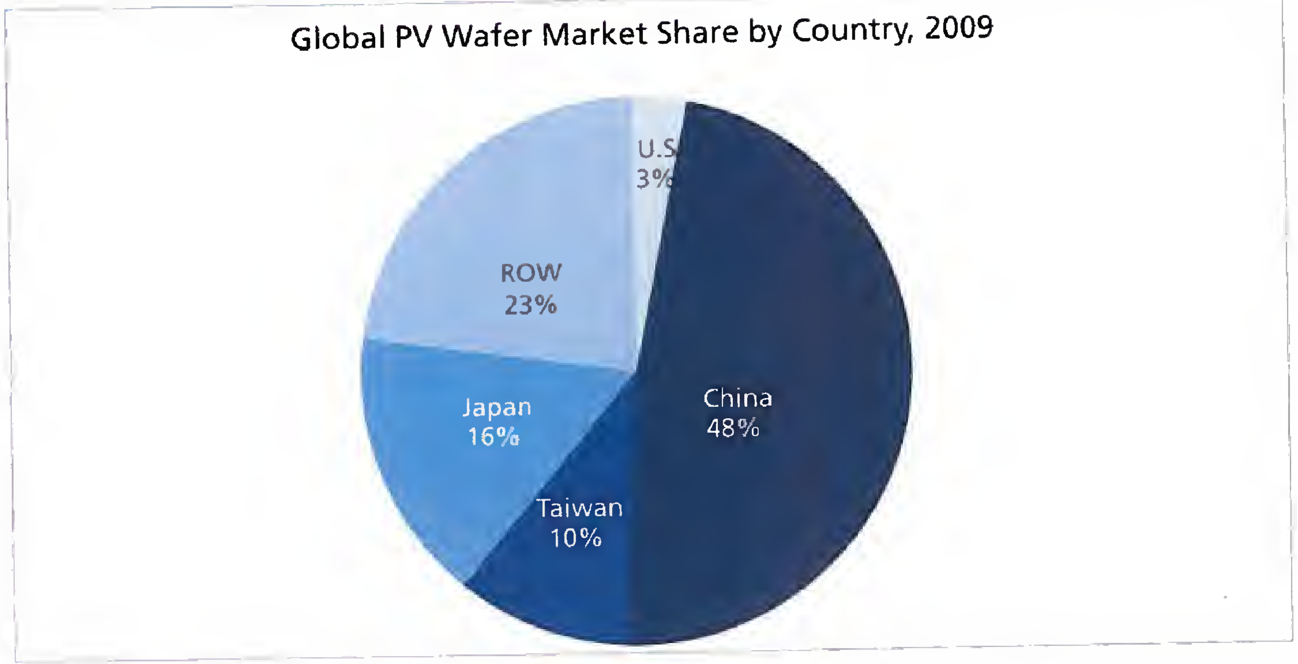
2.2.2 Ingot and Wafer Production

Once high-purity polysilicon is obtained, it is then melted and cast into large bricks or ingots, which are either cylindrical or rectangular in shape. The large ingot is sawed into smaller bars, which are then sliced into thin (180 to 200 micron) wafers using wire saws.

As with polysilicon, the percentage of value created domestically by wafers in a U.S.-installed system was estimated based on U.S. share of global production. Global wafer production is dominated by Asian manufacturers,

particularly those in China and Taiwan, and Western countries such as the U.S. and Germany have seen their market share fall significantly in recent years. Unlike polysilicon, where the U.S. made up 40% of global production, only 3% of PV wafers manufactured worldwide in 2009 were produced in U.S. facilities. Thus, a large percentage of the value of wafers that eventually become part of installed PV systems in the U.S. is estimated to come from foreign sources. It should be noted that the methodology employed is conservative, as U.S. cell producers are likely to source wafers from domestic suppliers in a higher proportion than their share of the global mix.

Figure 2-2: Global PV Wafer Market Share, 2009



Source: GTM Research

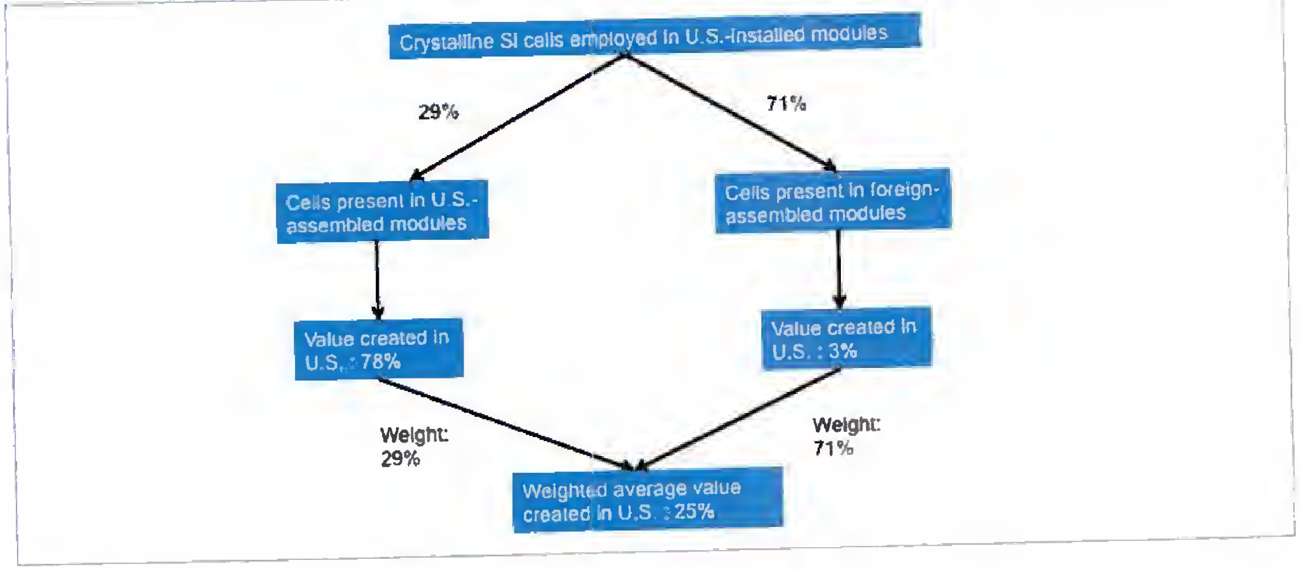
Source: PV-Tech

2.2.3 Cell Production

The photovoltaic cell is the basic energy-producing unit of a PV system. Wafers are converted into cells by means of a highly automated process that involves etching, rinsing, diffusion (introduction of impurities that makes the wafer photoelectrically active), coating, and screen printing.

As with wafers, the U.S. is not a major player when it comes to crystalline silicon cell manufacturing: only 256 MW of the 8,757 MW c-Si cells produced in 2009 were manufactured in the U.S., which amounts to a global market share of 3%. Intuitively, however, one would expect U.S.-installed modules to have a proportionally higher share of U.S.-sourced cells; the availability of the relevant data in this case actually allows one to investigate this and make a more accurate determination of the percentage of value created domestically in the case of cells. To do so, the percentage of domestic value created in the c-Si cells that were used in modules assembled domestically versus abroad were considered separately, and then blended together on a weighted average basis: this yielded a final estimate of 25% domestic value creation. The diagram in Fig 2-3 below provides a graphical illustration of the methodology employed, which is explained in further detail in the Appendix.

Figure 2-3: Graphical Illustration of Estimation Methodology for Domestic Value Created, Crystalline Silicon Cells



Source: GTM Research

Figure 2-4: Calculation for Percentage of Value Created – Crystalline Silicon Cells

CRYSTALLINE SILICON CELLS	
Modules Assembled in U.S.	
Volume - c-Si (MW)	256
Cell Imports (MW)	79
[illegible]	[illegible]
Modules Assembled Outside U.S.	
2009 Production - Global (MW)	8,757
2009 Production - U.S. (MW)	256
[illegible]	[illegible]
U.S.-Assembled c-Si Modules (% of U.S.-installed c-Si modules)	29%
% OF VALUE CREATED IN U.S. - FINAL	**25%**

Source: GTM Research

2.2.4 Module Assembly

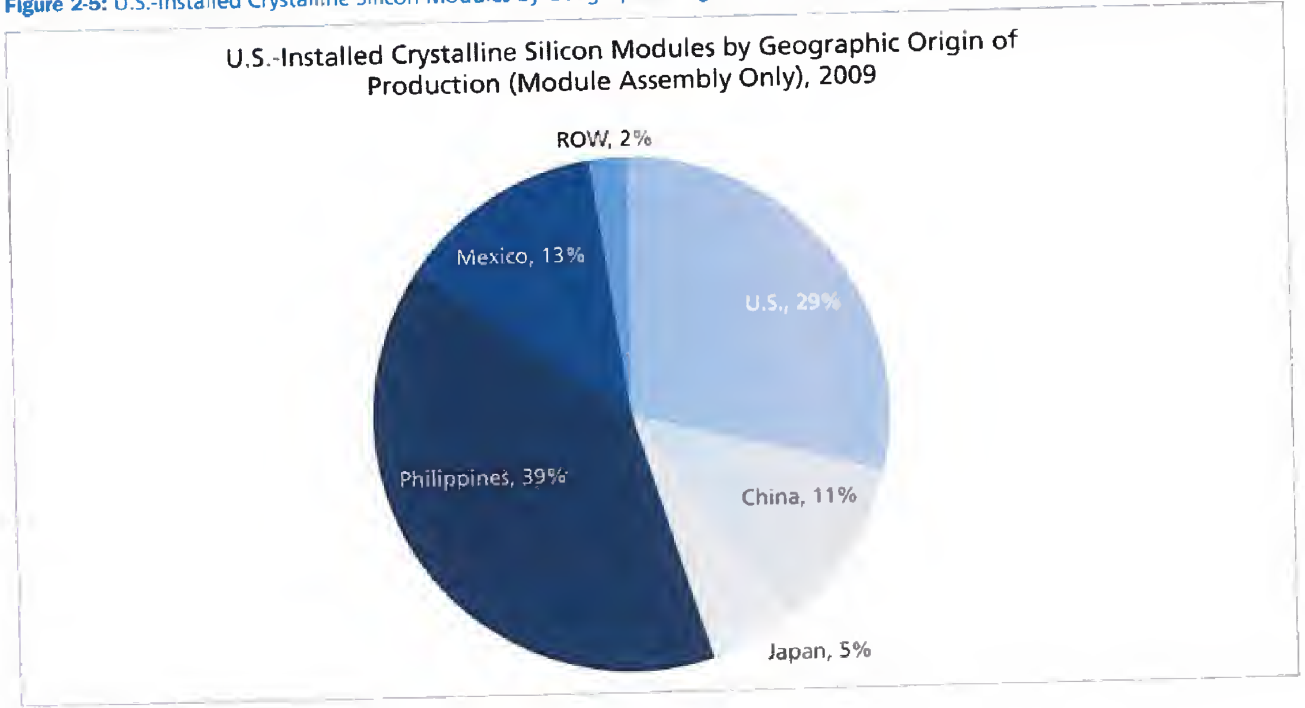
The final step in the production of a finished crystalline silicon module involves stringing the cells (typically 60 or 72 of them) into a series/parallel connection to obtain the voltage and power level desired for a particular module power capacity. The cell string, arrayed side by side to "fill" a rectangular area, is then packaged and laminated between a sheet of tempered glass, ethyl vinyl acetate (EVA), and a back cover of metallic foil, a polyvinyl fluoride film, or glass.

Source: Suntech Power Holdings

To estimate the percentage of value created domestically by module assembly, module manufacturer-specific data from residential and commercial systems from California and New Jersey, as well as national utility-scale installation data was examined to calculate what percentage of U.S. installations used modules from domestic manufacturers. Overall, 29% of U.S.-installed crystalline silicon modules were assembled domestically in 2009; this is much higher than the U.S. share of global c-Si module manufacturing in 2009, which was only 6%. This figure demonstrates the conservativeness of the estimated percentage of value created for c-Si wafer manufacturing, where it was assumed that the percentage of foreign wafers was strictly in accordance with U.S. global market share.

It is worth noting that despite the relatively low share of domestic value in U.S.-deployed crystalline silicon modules, U.S. crystalline silicon module production in 2009 (which was 428 MW) actually exceeded domestic consumption of the same (366 MW), suggesting that a significant number of U.S.-produced modules was exported. This was indeed the case: as discussed in Section 2.11.4, domestic module exports exceeded $1 billion in 2009.

Figure 2-5: U.S.-Installed Crystalline Silicon Modules by Geographic Origin of Production (Module Assembly Only), 2009



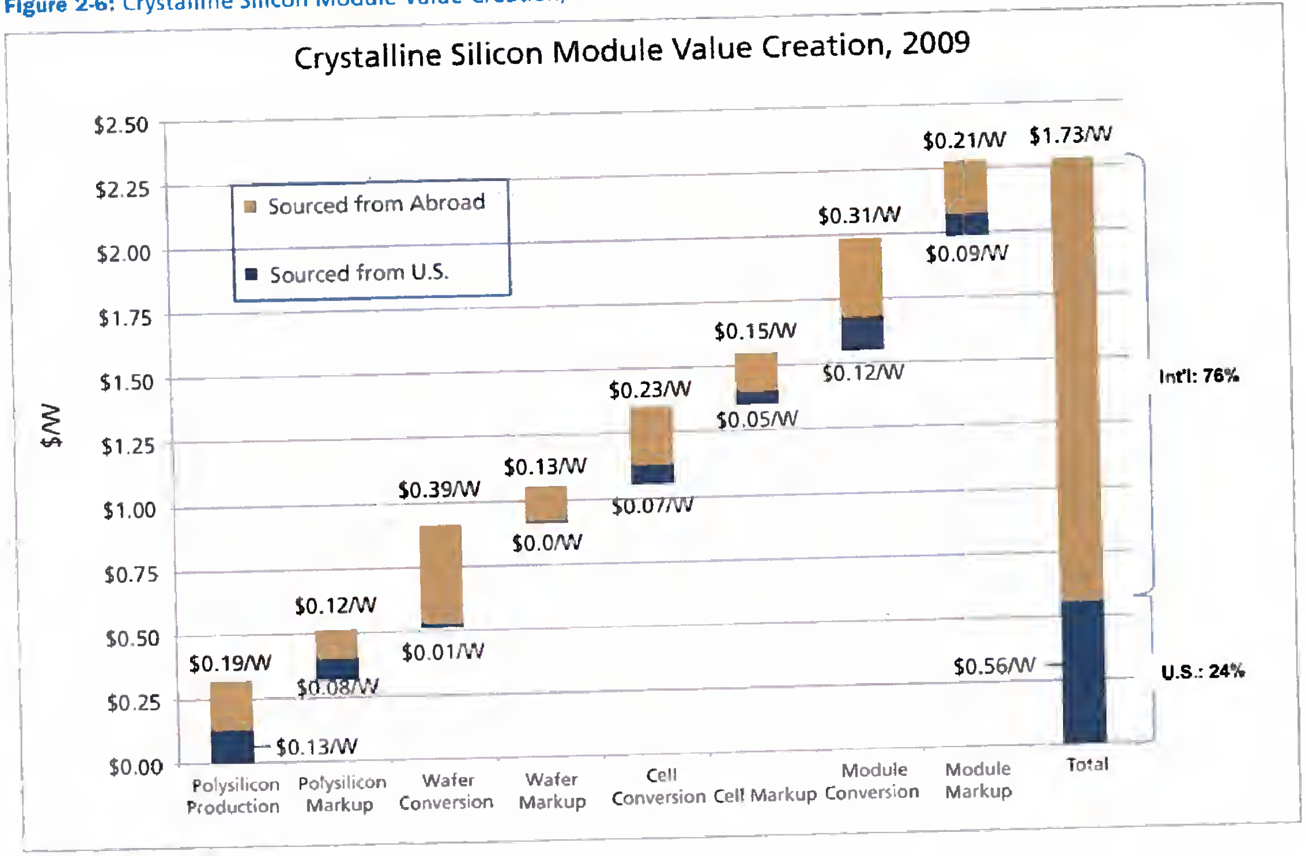
Source: GTM Research

2.2.5 Crystalline Silicon Module

The figure below shows the breakdown of the cost structure for a crystalline silicon module in 2009, including markups; the overall figure is thus indicative of what is known in industry as "factory-gate" pricing. As shown, this amounts to a total

of $2.28/W. Polysilicon, cell, and wafer production (including markup) have a roughly equal share of the total (around 22%), while module assembly is the highest-cost process, at 32%. Of this $2.28/W, a total $0.56/W, or 24%, is estimated to be domestically sourced. As expected, the bulk of this (75%) comes from polysilicon and module assembly. In conclusion, the majority (76%) of the value of U.S.-installed crystalline silicon modules is created in regions outside the U.S.

Figure 2-6: Crystalline Silicon Module Value Creation, 2009



Source: GTM Research

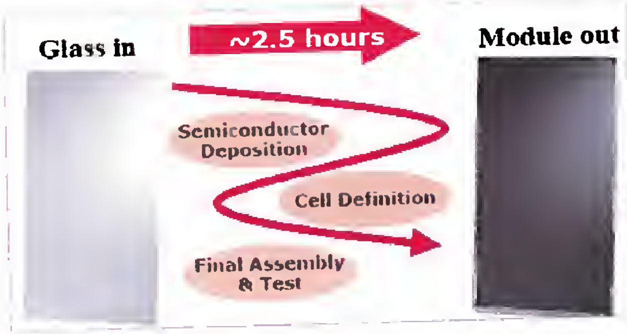
2.3 Thin Film PV Modules

Unlike crystalline silicon, where the photovoltaic material is a 180-200 micron thick wafer, thin film technology utilizes layers only a few microns thick as the light-absorbing material, deposited onto a substrate, such as glass or metal foil, and using a film manufacturing process. To date, three thin film technologies have been commercialized at mass production scale; these are cadmium telluride (or CdTe), amorphous silicon (or a-Si), and copper indium (gallium) diselenide (or CIGS); the names represent the composition of the film that acts as the photoactive layer in the module. Since 95% of 2009 U.S. thin-film module installations were CdTe-based (in fact from a single module vendor, First Solar), it is assumed that the thin film module and system in question are CdTe for the purpose of this analysis. A pictorial depiction of the manufacturing process for thin film modules is presented below.

Just as with the nature of the absorber layer, the manufacturing process for thin film modules is also markedly different from that of c-Si: most often, a sheet of glass goes in at one end of the production line, to be converted into a finished module just a few hours later. This means that the entire production process can take place inside one facility, compared to c-Si, where polysilicon, ingot/wafer, cell, and module production often take place in different factories. Because of this, the thin film module is broken down by its cost components rather than by value chain segment for the purposes of this analysis. At a high level, these are the following:

- Feedstock
- Capital Equipment
- Glass
- Encapsulant
- Junction box/cable
- Labor
- Utilities
- Overhead

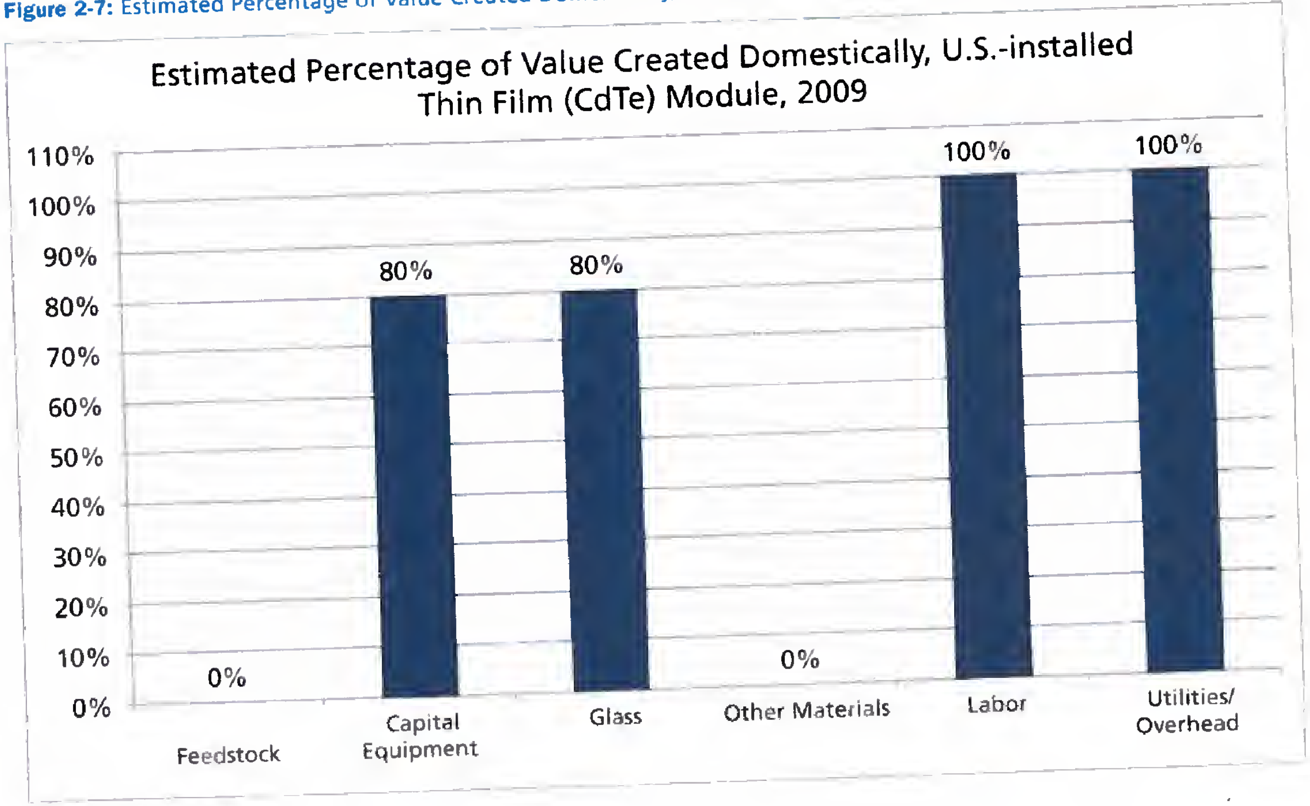
To determine the percentage of value created domestically for a thin film installation, the cost components above were examined individually. Figure 2-7 displays the domestic share assumed for each. These assumptions are believed to be conservative given a lack of public disclosure; it is highly likely, for example, that a significant proportion of the encapsulant and junction box was sourced domestically.



Source: First Solar

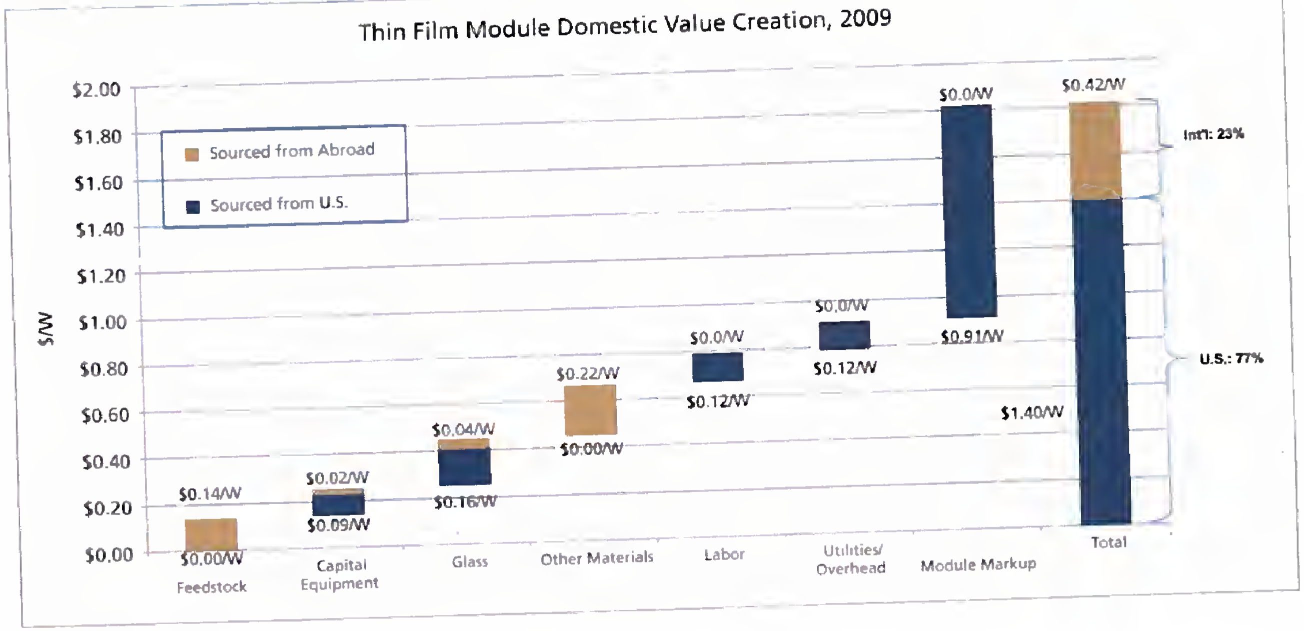
As shown below, total thin film module costs (including module markup) for 2009 amount to $1.82/W; of this, the cost to the producer is estimated at $0.91/W, while the remaining $0.91/W (50%) is markup at the module level. This may seem unreasonably high; however, it is in accordance with CdTe module economics in 2009, as the dominant CdTe producer recorded gross margins in excess of 50% throughout 2009, due to a relatively high price for the alternative PV technology (crystalline Si) and an industry-leading module manufacturing cost. $1.40/W (77%) of the value in U.S.-installed thin film modules was sourced domestically, in contrast to only 24% for crystalline silicon modules. This is largely because of two reasons: one, the leading thin film producer in the U.S. in 2009 in terms of module market share has manufacturing operations and is headquartered in the U.S., and two, thin film manufacturing is largely an integrated process. This means that both the raw costs as well as the module markup stay mostly within the U.S.

Figure 2-7: Estimated Percentage of Value Created Domestically, U.S.-installed Thin Film (CdTe) Module, 2009



Source: GTM Research

Figure 2-8: Percentage of Value Created Domestically, U.S.-installed Thin Film Module, 2009



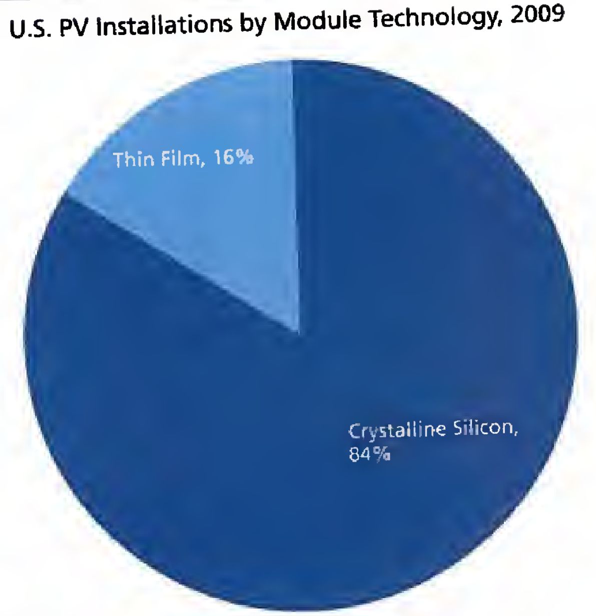
Source: GTM Research

The 77% domestic value of thin film modules installed in 2009, compared to only 24% for crystalline silicon, may lead one to mistakenly conclude that thin film manufacturing is inherently more U.S.-based. This is not true, and is more a function of the small sample size of prominent thin film manufacturers compared to crystalline silicon. To illustrate this, a crystalline silicon module manufactured by a highly integrated domestic manufacturer such as Solarworld (which produces wafers, cells, and modules in the U.S.) would have domestic value on par with that of a U.S.-produced thin film module. As such, there is nothing intrinsically American about thin film manufacturing, or intrinsically foreign about crystalline silicon production; it just so happens that the landscape of manufacturers of crystalline silicon PV is distributed across the globe and is extremely competitive, while few thin film firms have thus far been able to compete with the U.S.-based leader.

2.4 Blended PV Module

When considering the market share of crystalline silicon and thin film installations in 2009 (84% and 16% respectively), one arrives at a weighted average module cost of \$2.21/W. Of this, \$0.69/W is created domestically, which amounts to 31% of the total. On the whole, therefore, the majority of the cost for modules deployed in U.S. installations in 2009 came from foreign sources.

Figure 2-9: 2009 U.S. PV Installations by Module Technology



Source: GTM Research

Figure 2-10: Percentage of Value Created Domestically, PV Module, 2009

TECHNOLOGY	MODULE COST	DOMESTIC VALUE CREATED ($/W)	DOMESTIC VALUE CREATED (%)
Crystalline silicon	$2.28	$0.56	24%
Thin film	$1.82	$1.40	77%
Blended (weighted average)	$2.21	$0.69	31%

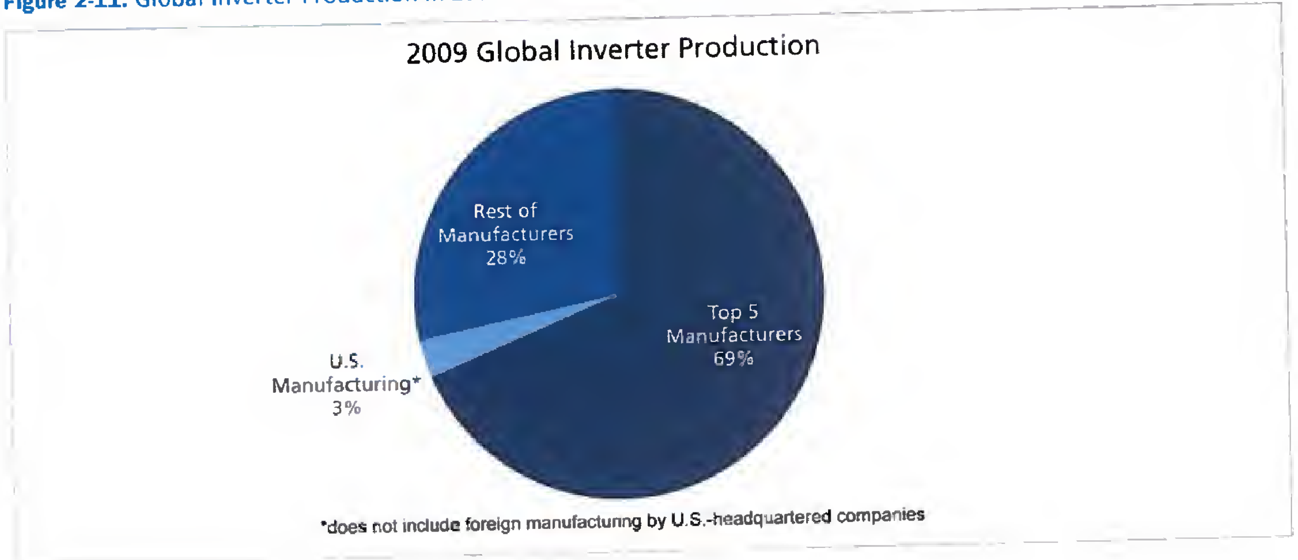
Source: GTM Research

2.5 Inverter

PV modules generate direct current (DC) electricity while the electric grid runs on alternating current (AC) requiring one or more inverters in each PV system to convert DC to AC. Ranging from small textbook-sized devices for residential-use to container-sized solutions for utility system-use, inverters represent the main power electronics unit in a typical PV system. Although the inverter is a critical technical component, the direct manufacturing costs only represent 5% of total installed system costs.

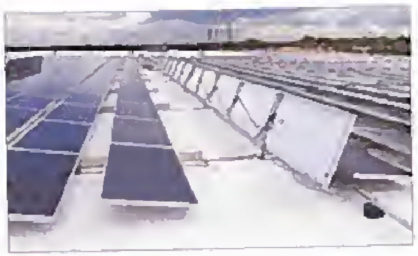
Global PV inverter sales reached over $2.5 billion in 2009, with European inverter companies dominating sales. The top five inverter companies represented more than two-thirds of all sales, each with manufacturing based abroad—mostly in Europe—in 2009. Two of these five companies have since expanded capacity into the U.S. in 2010. However, U.S. production is still small compared to global production. A few domestic manufacturers produce inverters, but provide only an estimated 35% of inverters used in all U.S. PV installations.

Figure 2-11: Global Inverter Production in 2009



Source: GTM Research

2.6 Mounting Structure



Source: SunLink

Mounting structures for PV modules, typically a pre-engineered system of aluminum or steel racks, accounted for approximately 6% of total PV system costs in 2009. Mounting structures vary depending on the site of the PV system, with different solutions for residential (shingle) and commercial (flat membrane, sloped metal, etc.) roofs in addition to ground-mounted systems.

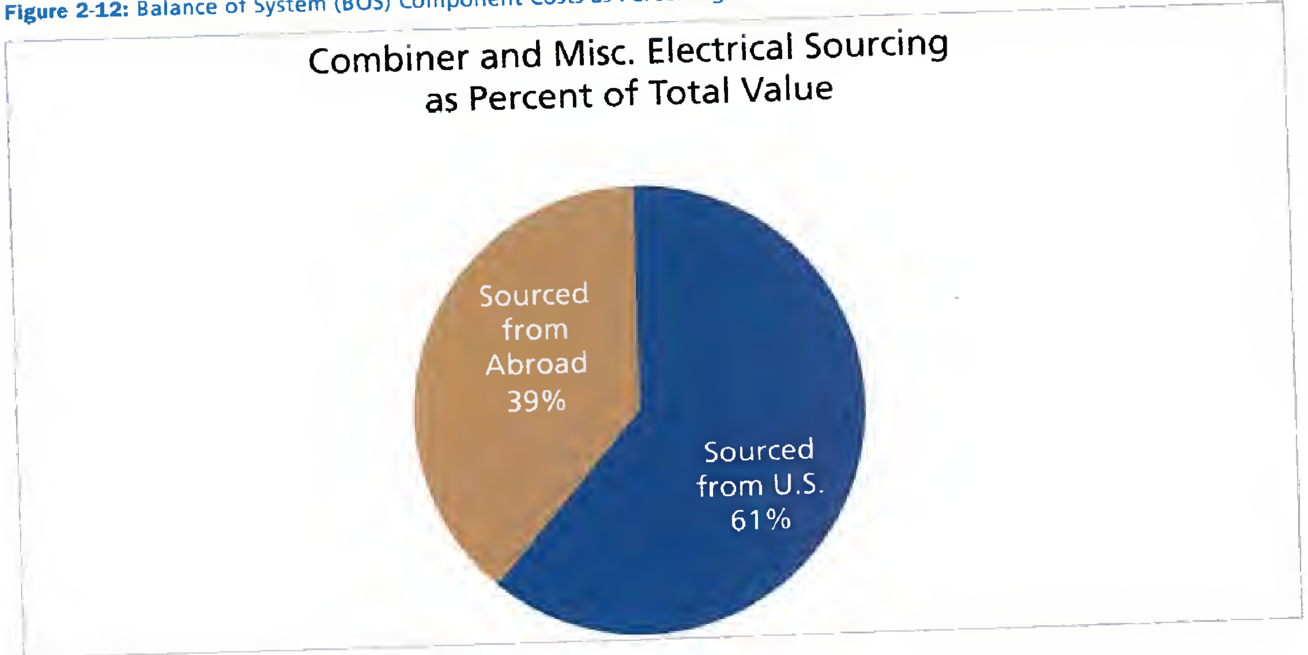
Because of the local abundance and substantial weight of racking structures, long distance shipping is prohibitively expensive. As a result, 84% of installed PV capacity in the U.S. utilized mounting structures produced or assembled in America. Foreign-produced mounting structures are typically sourced from Mexico, as lower labor costs and proximity can override international shipping logistics and costs.

2.7 Combiner Box and Miscellaneous Electrical Materials

Source: Amtec Solar

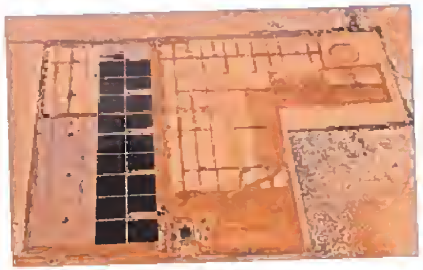
The remainder of installed materials, including combiner boxes, wires/conductors, conduit, data monitoring, and other miscellaneous hardware, are included in this category. Combiner boxes are the only solar-specific product included this category and are estimated to be 69% sourced from U.S. suppliers. Other miscellaneous electrical hardware are defined as commodity products and the domestic value proportion is estimated based on international trade flows. In general, the U.S. is a net exporter of wires and conduits and a net importer of disconnects, overcurrent protection and other electrical hardware. These materials are, however, produced in large volumes in the U.S. and imported equipment is typically bought through U.S. wholesalers and integrators, so there is upside potential to the estimate that 61% of the total value for balance of electrical equipment comes from the U.S.

Figure 2-12: Balance of System (BOS) Component Costs as Percentage of Overall BOS Costs, 2009



Source: GTM Research

2.8 Site Preparation, Labor, Soft Costs and Value Chain Markup



Source: PV-Tech

Site preparation, labor, soft costs and value chain markup constitute the balance and majority of the costs associated with an installed PV system. Site preparation and labor are defined as any logistical and physical preparation, coordination and work that must be performed to install a PV system at the site. This includes civil, structural or electrical infrastructure improvements, transporting materials on-site, and mechanical and electrical installation. Labor costs vary widely from project to project depending on the existing site conditions, the mounting structure employed, the size of

the installation, labor rates and local fire and safety codes. Site preparation and labor must be done at the site of the installation, ensuring that U.S. workers capture the full value of the estimated cost.

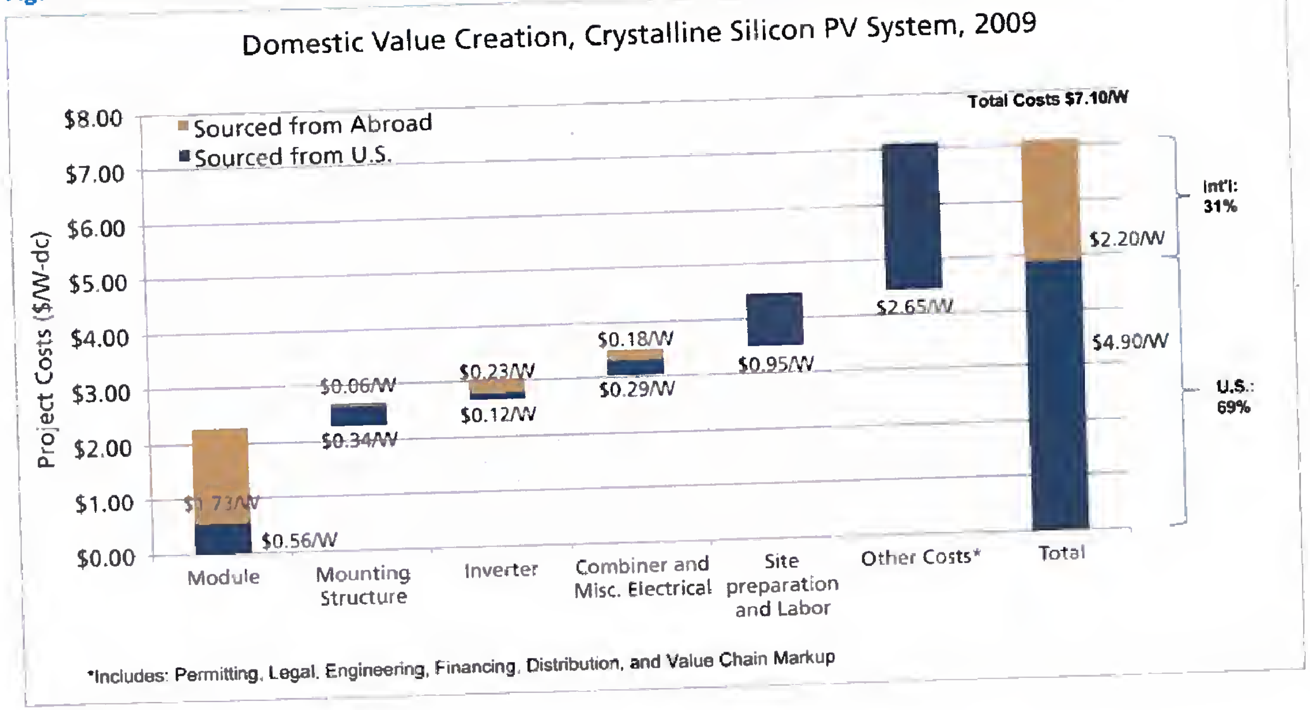
Soft costs include system design and engineering, legal fees, permitting fees, financing preparation, etc., all of which are typically performed by U.S. companies or U.S. subsidiaries of foreign companies. Value chain markup includes overhead and profit margins captured in the period between equipment manufacturing and final installation. In the U.S., more than half of installers procure components from distributors or wholesalers; only companies that procure in large volume purchase directly from solar equipment manufacturers. As a result, installed materials often undergo markups by both the distributor—typically between 15-20%—and the system installer. The combination of soft costs and value chain markup account for approximately 37% of total system costs.

2.9 PV System

2.9.1 Crystalline Silicon System

Crystalline silicon-based PV systems accounted for 84% of the U.S. PV market in 2009, with a weighted average installation cost of $7.10/W. Module costs are adjusted to reflect average selling prices for crystalline silicon modules; other system costs are calculated with the same methodology as described above. As explained in earlier sections, crystalline PV modules are predominantly sourced from abroad, with only 24% of the value created from the average module sourced from the U.S. Although the PV module accounts for nearly one-third of total system costs, the bulk of installed costs remain in the U.S. primarily due to the labor and soft costs necessary to transform PV components to a working system.

Figure 2-13: Domestic Value Creation, Crystalline Silicon PV System, 2009

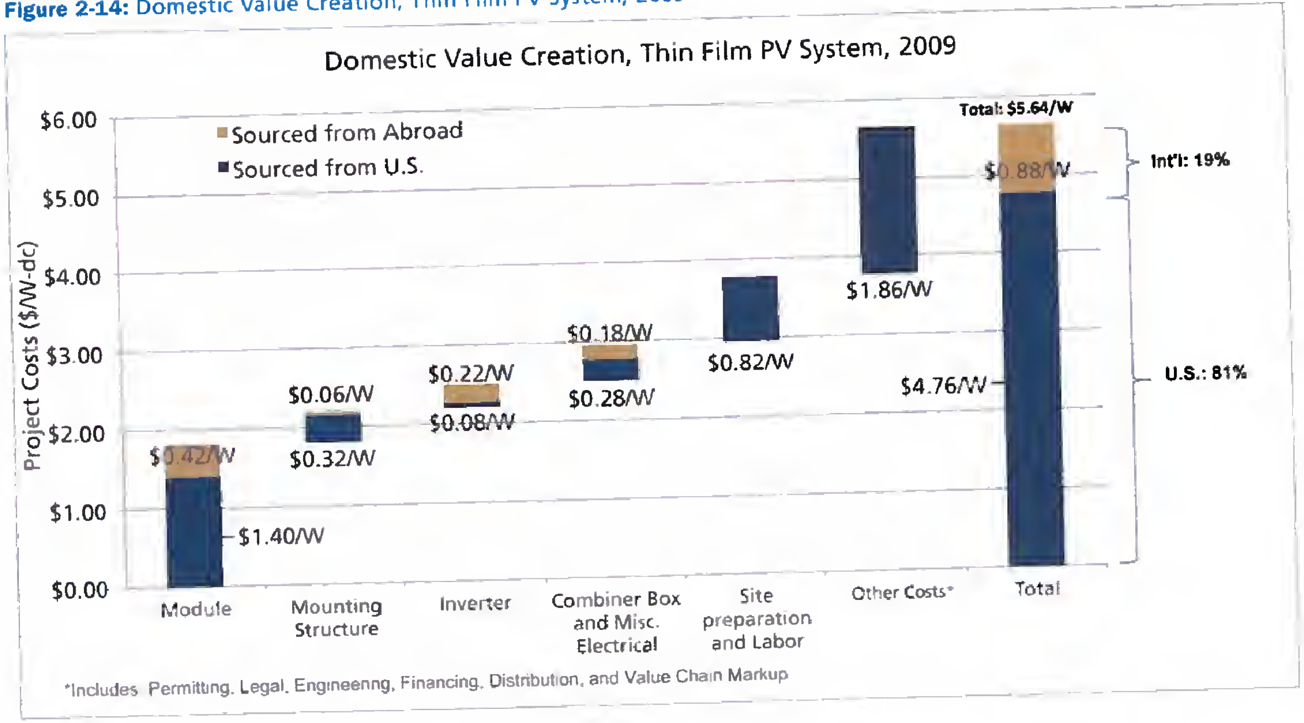


Source: GTM Research

2.9.2 Thin Film System

In 2009, thin film systems are estimated to have drawn 81% of their value from domestic sources, offsetting lower labor, soft costs and markups with a higher domestic content within the PV module. Note that the size of a single 25 MW system thin film project distorts the overall blended costs for U.S. thin film PV systems and, as a result, do not accurately represent any individual installed thin film projects in 2009.

Figure 2-14: Domestic Value Creation, Thin Film PV System, 2009



Source: GTM Research

2.10 Blended System

Capacity-weighted average installed price for all PV systems in 2009 is estimated to be $6.90/W, individual project costs had great variability depending on the size of installations, location of installation and components employed. Best practice installed prices were far lower than average system prices, especially for large commercial and utility scale systems. System prices fell precipitously throughout 2009, mostly due to drops in module prices. However, $6.90/W is used to represent a "typical" installed PV system in 2009, representing a weighted blend of residential,

commercial, and utility systems. The resulting blend does not accurately reflect any given sector, but most closely resembles the breakdown for a small commercial-sized system using crystalline silicon modules.

Figure 2-15: Breakdown of Typical U.S. PV Installation and Resulting Value Created for the U.S., 2009

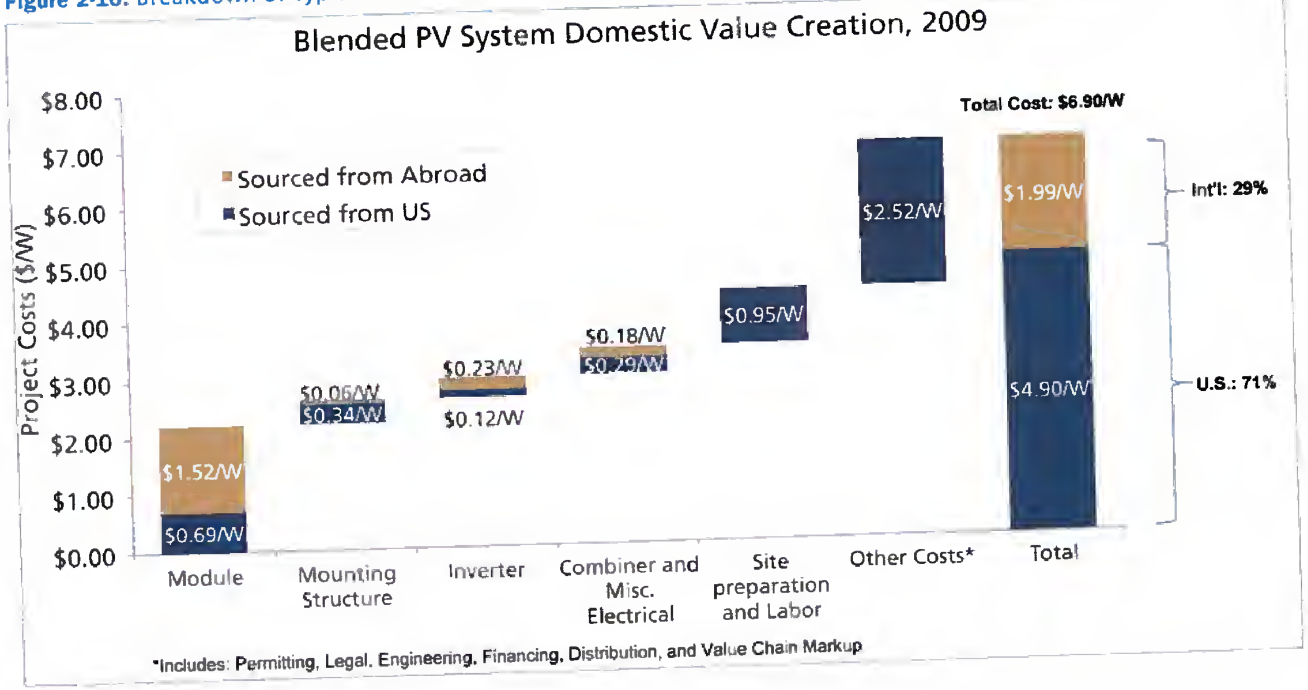
Domestic Value Created by U.S. Blended PV Installations, 2009				
System Component	**$/W**	**% of Total System Cost**	**% U.S. Sourced**	**Domestic Value created**
Module	$2.21	32%	31%	$0.69
Mounting Structure	$0.40	6%	84%	$0.34
Inverter	$0.35	5%	35%	$0.12
Combiner and Misc. Electrical	$0.47	7%	61%	$0.29
Site Preparation and Labor	$0.95	14%	100%	$0.95
Other Costs*	$2.52	37%	100%	$2.52
Total	$6.90	100%	71%	$4.90

*Includes: Permitting, Legal, Engineering, Financing, Distribution, and Value Chain Markup

Source: GTM Research

By integrating the estimated domestic content in each sub-category of PV system costs, it is found that 71% of PV system value was created in the U.S. The majority of U.S.-created value comes from site preparation, labor, soft costs, and value chain markup—work that is impossible or extremely difficult to outsource. Examining only physical components, approximately 42% of the value created by modules, mounting structures, inverters, and balance of systems remains in the U.S. However, non-tangible system costs in the form of engineering, logistics, labor and overhead make up 51% of the total system costs, with full value attributed to U.S. sources. Thus, while the majority of PV installations sport components with foreign brands, over two-thirds of the costs of a PV installation directly benefits the U.S.

Figure 2-16: Breakdown of Typical U.S. PV Installation and Resulting Value Created for the U.S., 2009



Source: GTM Research

2.11 Trade Flow Analysis

Separate from, but related to, the issue of domestic value created is the issue of trade flows. The essential question is simple: how much solar energy-related materials and components does the U.S. import vs. export, and to which countries? In keeping with the segmented nature of the PV value chain (crystalline silicon PV technology in particular), trade flows are assessed separately for the following aspects, before being combined in the final analysis:

- Polysilicon
- Wafers

- Cells
- Modules (both crystalline Si and thin film)
- Inverters

It should be noted that the trade flow data for PV in this report include feedstocks for silicon PV, but do not include feedstocks for non-silicon, thin film PV. Our research indicated that the total value of feedstocks used in U.S. non-silicon, thin film manufacturing in 2009 was of a value inconsequential to the solar trade flow levels considered in this report.

2.11.1 Polysilicon

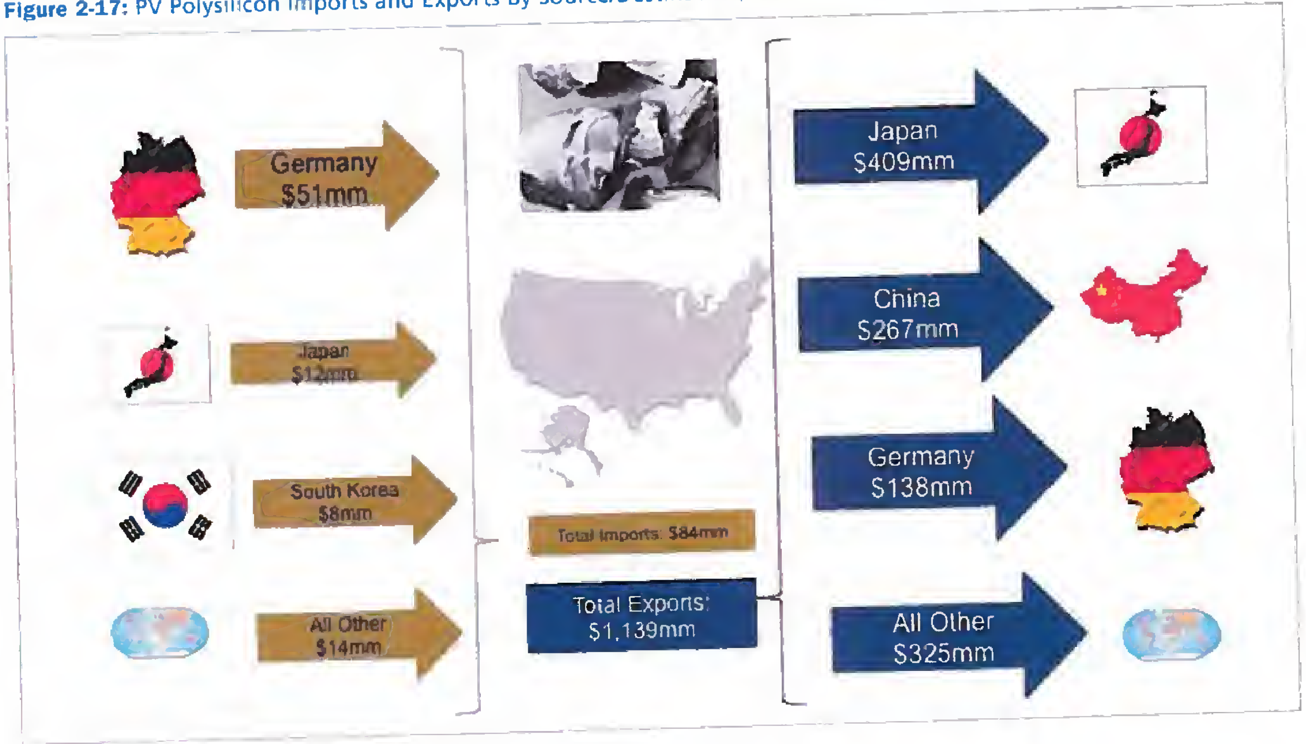
To assess polysilicon trade flows in 2009, the following methodology was used:

- GTM Research's proprietary database was first used to track polysilicon production by manufacturer.
- The percentage of U.S. production sold domestically was then estimated based on available data and interviews with polysilicon vendors.
- Exports were estimated by summing foreign sales across all domestic manufacturers.
- Imports were estimated by taking the difference of domestic polysilicon consumption (based on domestic wafer production data owned by GTM Research) and U.S. production that is sold domestically, calculated earlier.

The results of this process are displayed below. As shown, the U.S. exported far more polysilicon ($1.1 billion) than it imported in 2009 ($83.9 million). The main reason for this is a strong domestic polysilicon manufacturing base and the near-absence of domestic wafer producers. This means that (i) The U.S. produces large quantities of polysilicon, (ii) very little of this is consumed domestically, and (iii) there is little or no need to import polysilicon.

As one would expect, the primary export locations correspond to global PV wafer manufacturing bases, namely Japan (which has a handful of large, vertically integrated wafer-to-module producers), China (including Taiwan), and Germany. Import locations include Germany, Japan, and South Korea.

Figure 2-17: PV Polysilicon Imports and Exports by Source/Destination, 2009



Source: International Trade Commission, GTM Research

2.11.2 Wafer

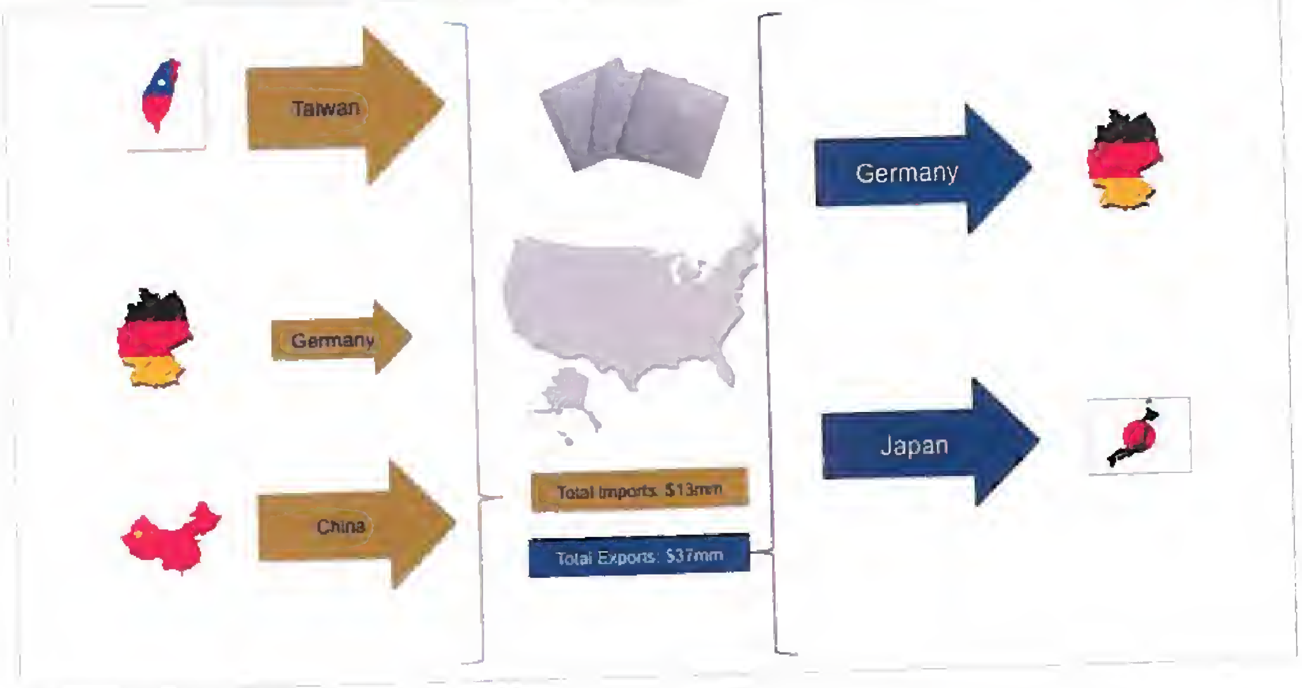
To assess PV wafer trade flows in 2009, the following methodology was used:

- GTM Research's proprietary database was first used to track wafer production by manufacturer.
- The percentage of U.S. production sold domestically was then estimated based on available data and interviews with wafer vendors.

- Exports were estimated by summing foreign sales across all domestic wafer manufacturers.
- Imports were estimated by taking the difference of domestic wafer consumption (based on domestic crystalline cell production data owned by GTM Research) and U.S. production that is sold domestically, calculated earlier.

As shown below, the U.S. was a slight net exporter of PV wafers (to the tune of $24.5 million) in 2009. Since it is not a major wafer or crystalline silicon cell manufacturing center, neither exports ($37.4 million) nor imports ($12.9 million) are large in magnitude. While quantitative data for country-specific imports and exports was not available for wafers, analysis of major sales contracts and data on global wafer and cell production indicates that major importers to the U.S. are Taiwan, Germany, and China, while wafer exports are sourced to Germany and Japan.

Figure 2-18: PV Wafer Imports and Exports by Source/Destination, 2009

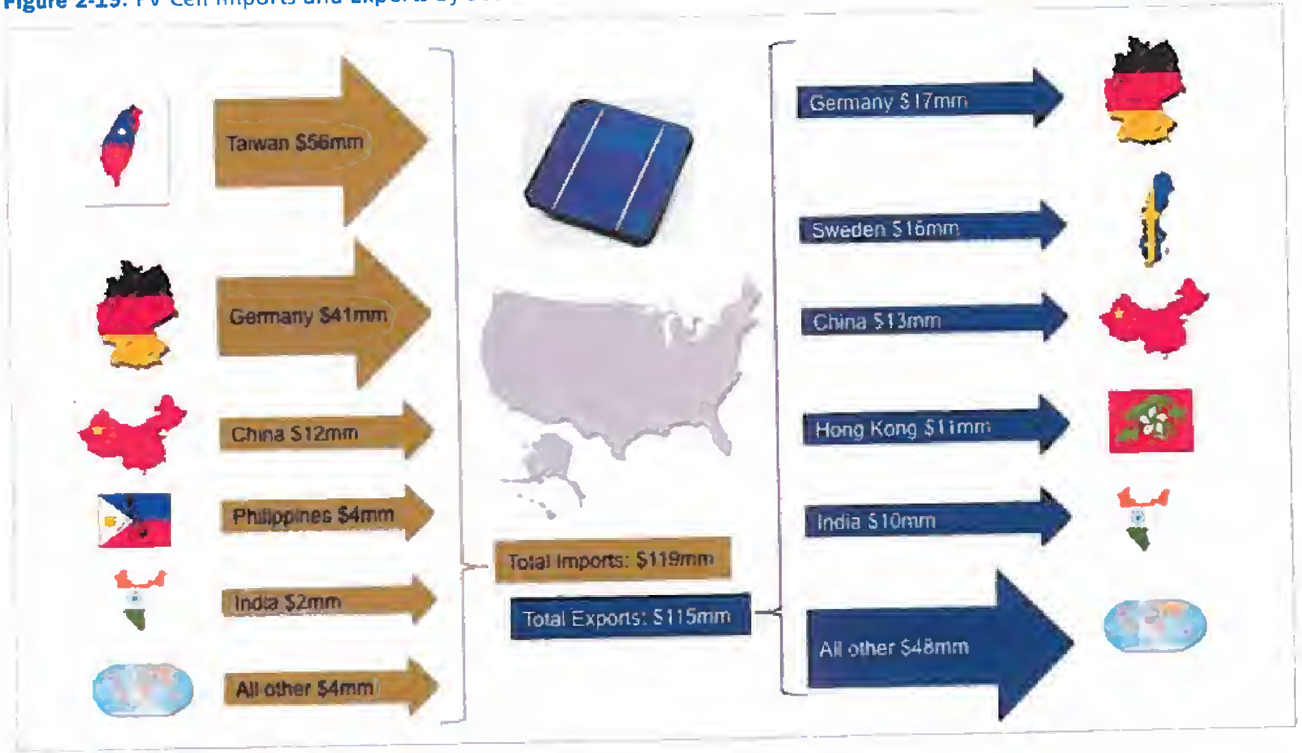


Source: GTM Research

2.11.3 Cell

Data for PV cell imports and exports was obtained from the U.S. International Trade Commission. The custom values in this case are only for cells that were not already assembled into modules; given the integrated nature of thin film manufacturing, it is therefore assumed that almost all of these cells are crystalline silicon in nature. As shown below, the U.S. exported almost as many cells ($115.3 million) as it imported in 2009 ($119.2 million). Key import sources include Taiwan and Germany, while export destinations include Germany, Sweden, and China.

Figure 2-19: PV Cell Imports and Exports by Source/Destination, 2009



Source: International Trade Commission, GTM Research

2.11.4 Module

As with cells, data for PV module imports and exports was obtained from the U.S. International Trade Commission; here, this would include both crystalline silicon and thin film modules. Total customs value for both module imports and exports exceeded $1 billion in 2009, with imports ($1.2 billion) exceeding exports ($1.0 billion) by around 23%. Like cells, this makes the U.S. a net importer of modules. While imports arise mostly from low-cost manufacturing locations such as China, Mexico, and Philippines and indicate the presence of a strong domestic end-market, exports are directed towards developed nations that also deploy PV installations in significant quantities: these include Germany, Canada, Italy, and France.

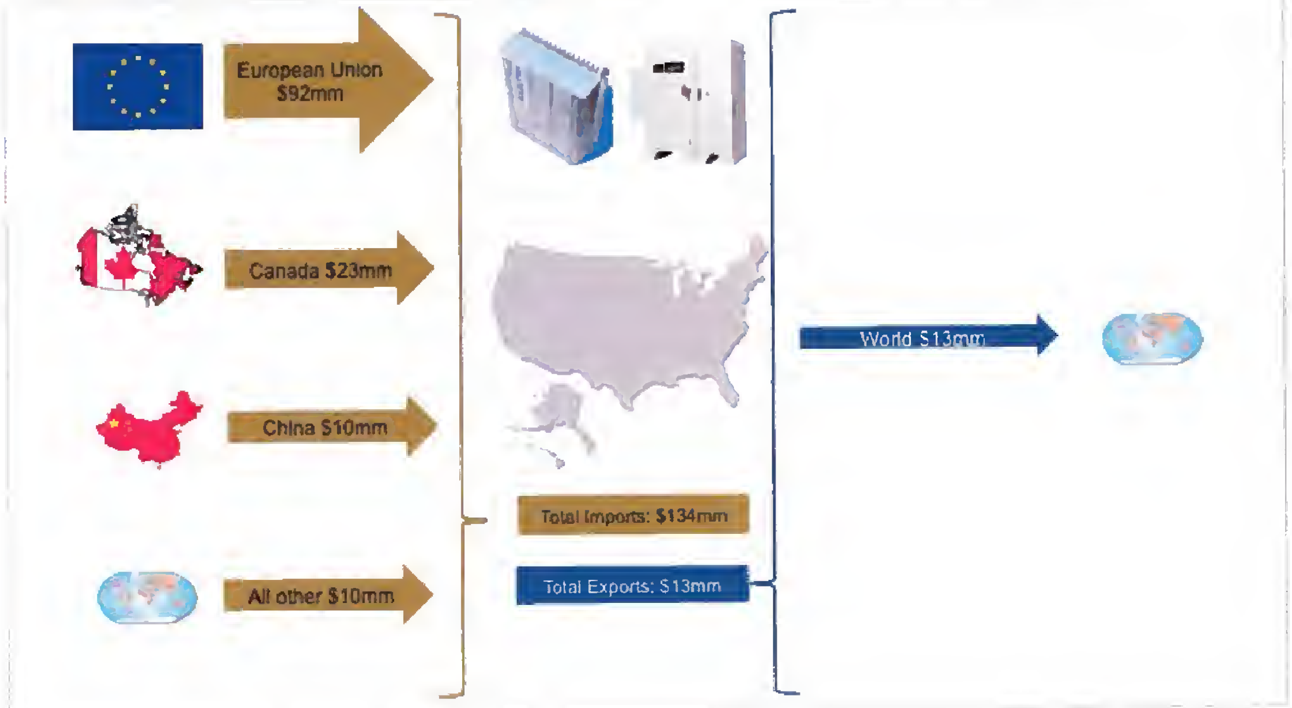
Figure 2-20: PV Module Imports and Exports by Source/Destination, 2009

Source: International Trade Commission, GTM Research

2.11.5 Inverter

Given the small fraction of domestic inverter assembly and manufacturing in the context of the global industry, the imbalance in trade is unsurprising. Foreign imports, mostly from Germany, accounts for over two-thirds of an estimated $134 million of domestic inverter imports. Exports by U.S. suppliers, mostly to North America, reached only approximately $13 million.

Figure 2-21: PV Inverter Imports and Exports by Source/Destination, 2009

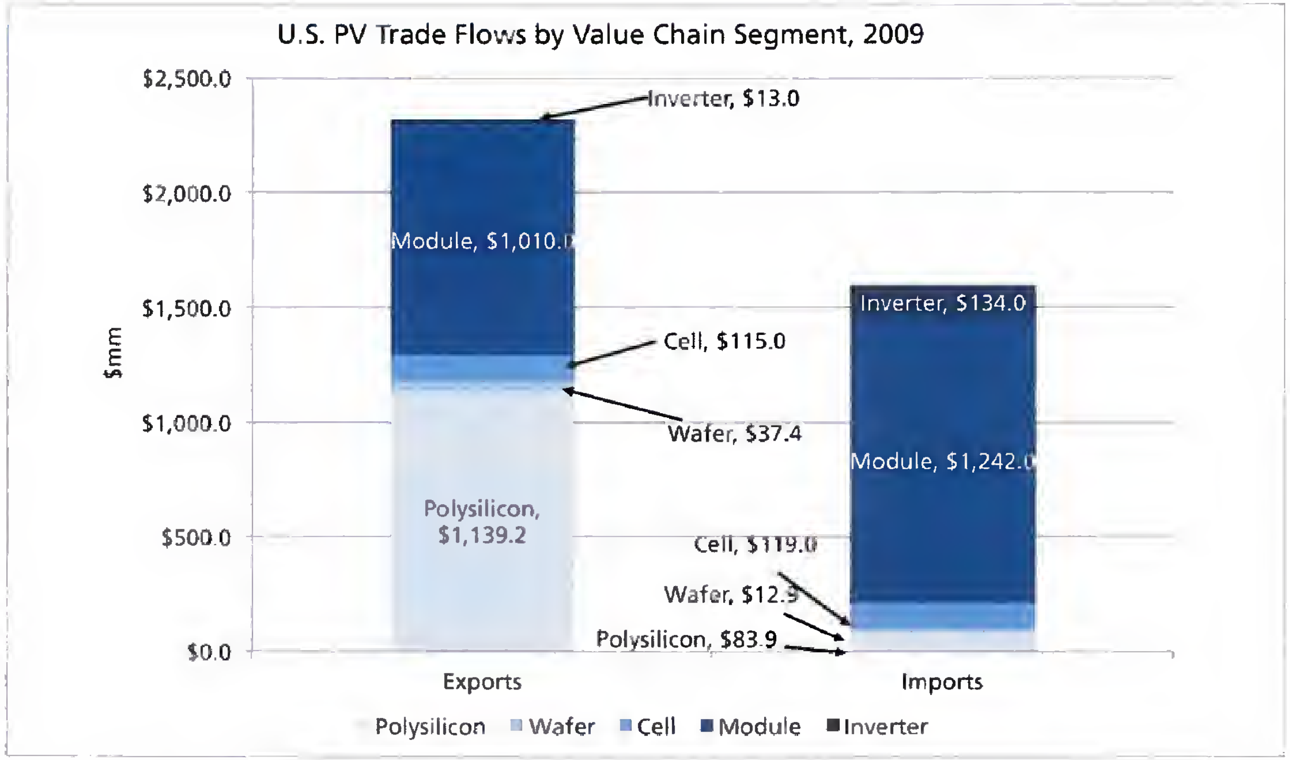


Source: GTM Research

2.11.6 Total PV Trade Flows

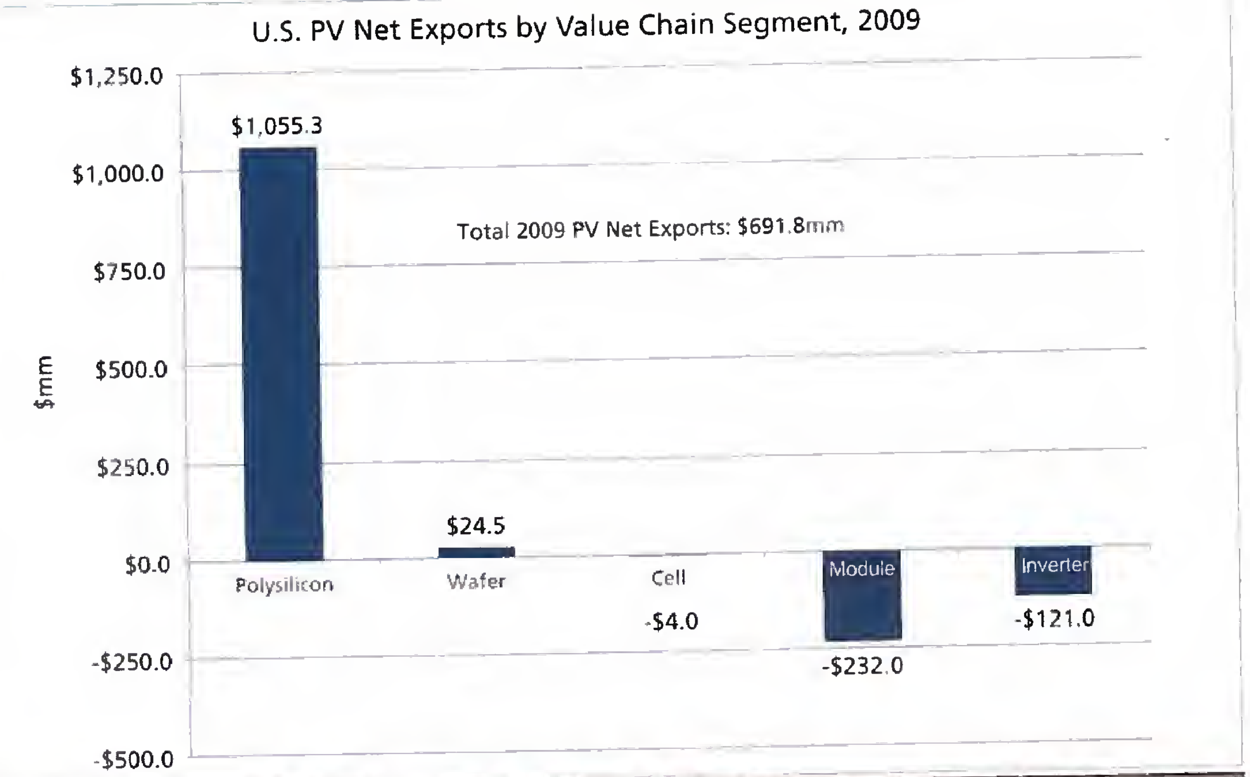
By summing trade flows for the individual components assessed, one arrives at total PV import and export volumes, which puts 2009 PV exports at $2.3 billion. This compares to imports of $1.6 billion, which yields net PV exports of $722.8 million. As shown, the primary export goods for PV in 2009 were polysilicon and modules, while inverters and modules were the main components imported. In terms of net exports, polysilicon was by far the most prominent, at $1.1 billion for 2009, while modules and inverters had the highest trade deficit, at $232.0 million and $121.0 million of net imports respectively.

Figure 2-22: U.S. PV Trade Flows by Value Chain Segment, 2009



Source: International Trade Commission, GTM Research

Figure 2-23: U.S. PV Net Exports by Value Chain Segment, 2009

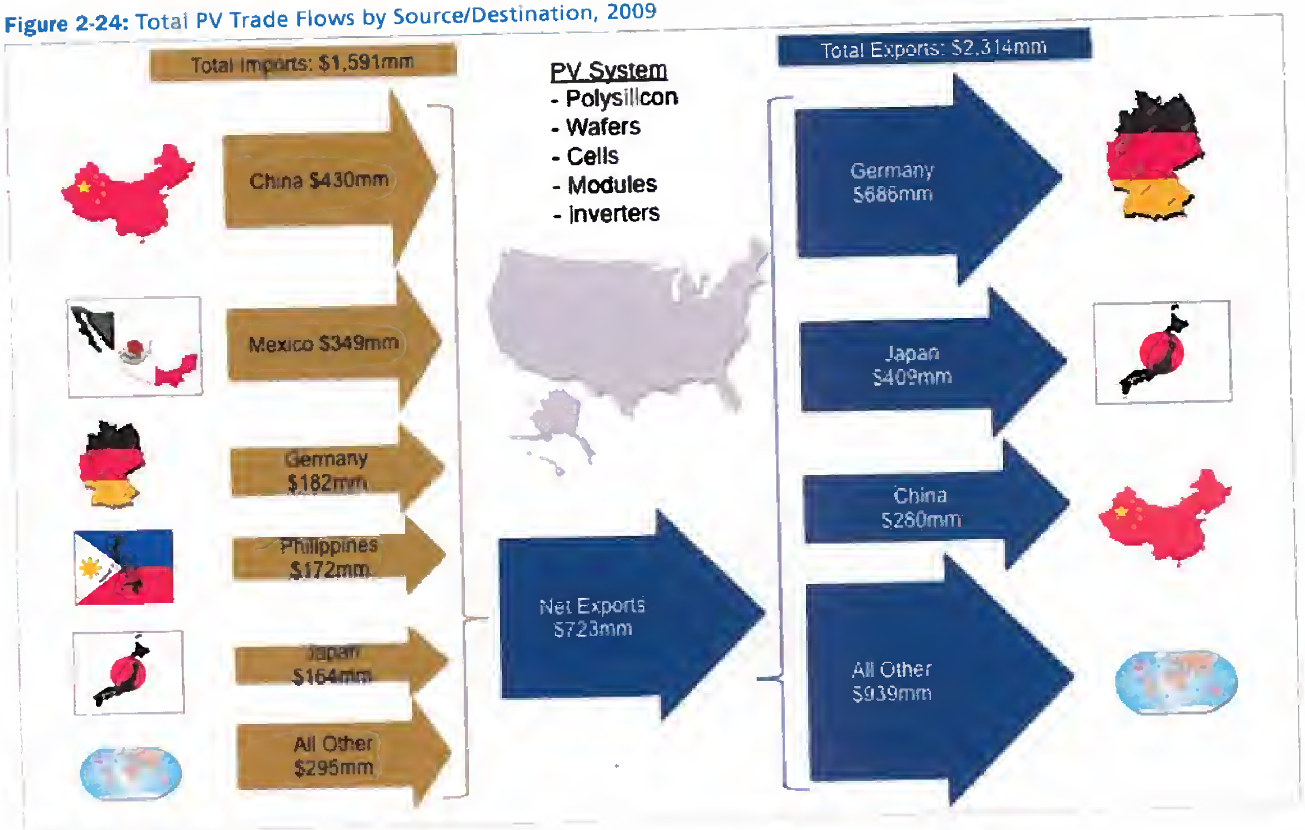


VALUE CHAIN COMPONENT	EXPORTS	IMPORTS	NET EXPORTS
Polysilicon	$1,139.2	$83.9	$1,055.3
Wafer	$37.4	$12.9	$24.5
Cell	$115.0	$119.0	-$4.0
Module	$1,010.0	$1,242.0	-$232.0
Inverter	$13.0	$134.0	$121.0
Total	$2,314.7	$1,591.8	$722.8

Source: International Trade Commission, GTM Research

When examining overall PV trade flows by geography, China and Mexico were the most prominent importers to the U.S. in 2009, with $430.0 million and $349.0 million of imports respectively; in both cases, module exports made up the bulk of customs value. Germany, Japan, and China were key export destinations for PV, at $686.2 million, $408.7 million, and $280.2 million of customs value respectively. While Germany's presence on this list is mostly due to module exports, Japan and China imported primarily polysilicon from the U.S. in 2009.

Figure 2-24: Total PV Trade Flows by Source/Destination, 2009



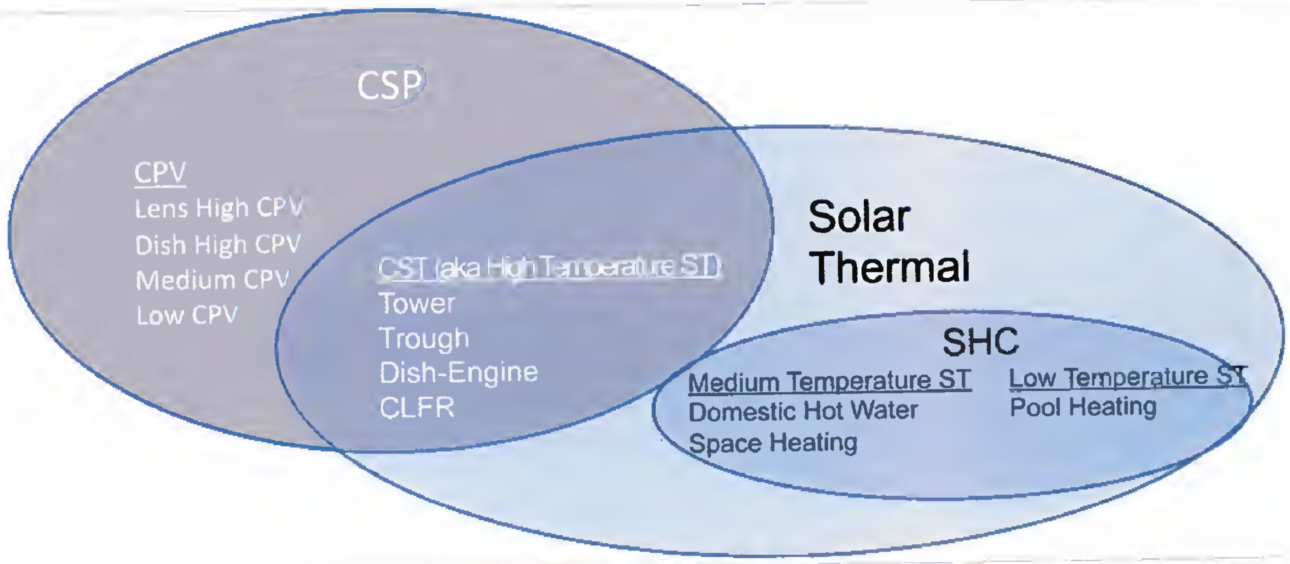
Source: International Trade Commission, GTM Research

3 CONCENTRATING SOLAR POWER (CSP)

3.1 Domestic Value Created

Concentrating Solar Power is a category of technologies that concentrate sunlight to either generate electricity directly (Concentrating Photovoltaics or CPV) or to generate steam for process heat or electricity generation (Concentrating Solar Thermal or CST). A diagram illustrating the technologies included in the CSP category is shown below.

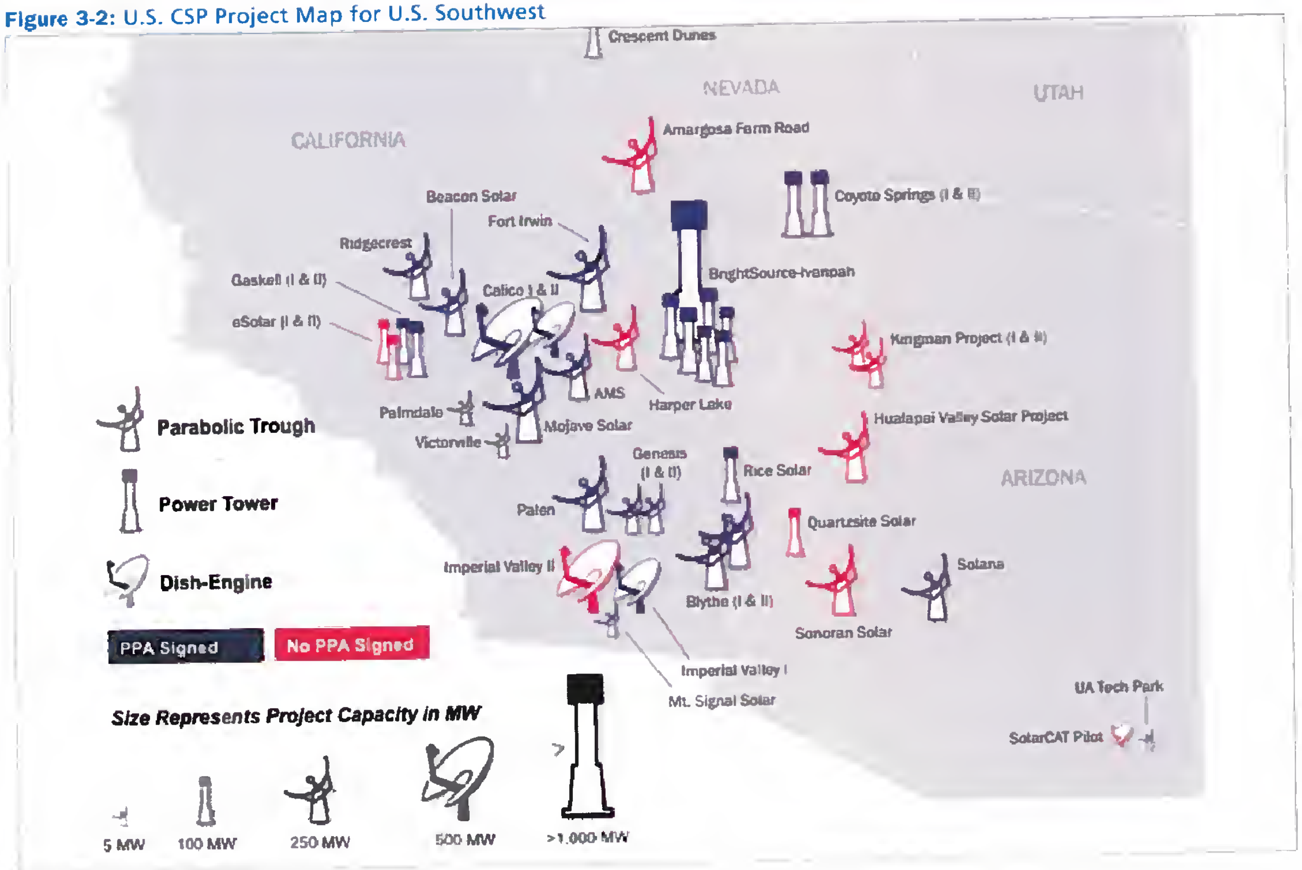
Figure 3-1: CSP Includes Both Concentrating PV and Concentrating Solar Thermal Technologies



Source: GTM Research

As shown in the U.S. CSP project map below, the majority of the projects with signed power purchase agreements (PPAs) will be utilizing parabolic trough and power tower technology. There are also numerous dish-engine projects with PPAs, but none of these have received conditional commitments for loan guarantees from the federal government, and as such they are less likely to move to the construction phase.

Figure 3-2: U.S. CSP Project Map for U.S. Southwest



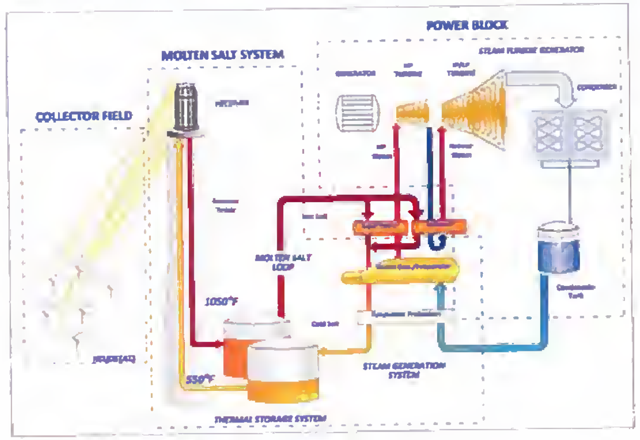
Source: GTM Research

Accordingly, for the purposes of this analysis, the focus will be on the two technologies that are most likely to see utility-scale projects move forward in 2011: power tower and parabolic trough. Images for both types of plants are pictured left. Power tower plants use flat mirrors called heliostats to direct sunlight onto a receiver mounted atop a central tower.

Source: BrightSource Energy

Parabolic Trough plants used curved mirrors to direct sunlight onto a receiver tube that runs the length of the collector. Inside the tube is a heat transfer fluid, such as synthetic oil, which is heated by the sunlight, and eventually used to generate steam to power a turbine.

Source: Abengoa Solar



Source: SolarReserve

As illustrated in the diagram to the left, a CSP plant has several major components. The collector field is the mirrors/heliostats that collect the sunlight and direct it towards the central receiver. The next part is the molten salt system/tower, which is where the heat transfer fluid is heated and then carried to the thermal storage system. The steam generation system uses the heat transfer fluid (either oil or molten salt) to produce steam which is carried to the final part of the plant. Lastly, there is the power block, where the steam powers a turbine generator to create electricity.

Whereas solar PV and SHC had sufficient installation volumes in 2009 to calculate meaningful domestic content breakdowns, CSP only had two demonstration-scale plants installed in 2009, both of which had atypical costs and sourcing that did not reflect expected sourcing for future utility-scale projects.

Accordingly, in order to calculate the percent of value that is domestically sourced, the analysis looked at the two CSP projects that are most representative, and the most likely to be built in 2011: Abengoa Solar's 280 MW Solana trough plant in Arizona and BrightSource Energy's 392 MW Ivanpah tower plant in California. For each category of the cost breakdown, the analysis determined where each project would be sourcing its materials, and then combined the results on a weighted basis (with Solana representing 42% of the total, and Ivanpah representing 58%).

Figure 3-3: CSP Percent of Value Created in the U.S.

U.S. CSP PROJECTS IN 2011: TOTAL VALUE CREATED IN THE U.S.

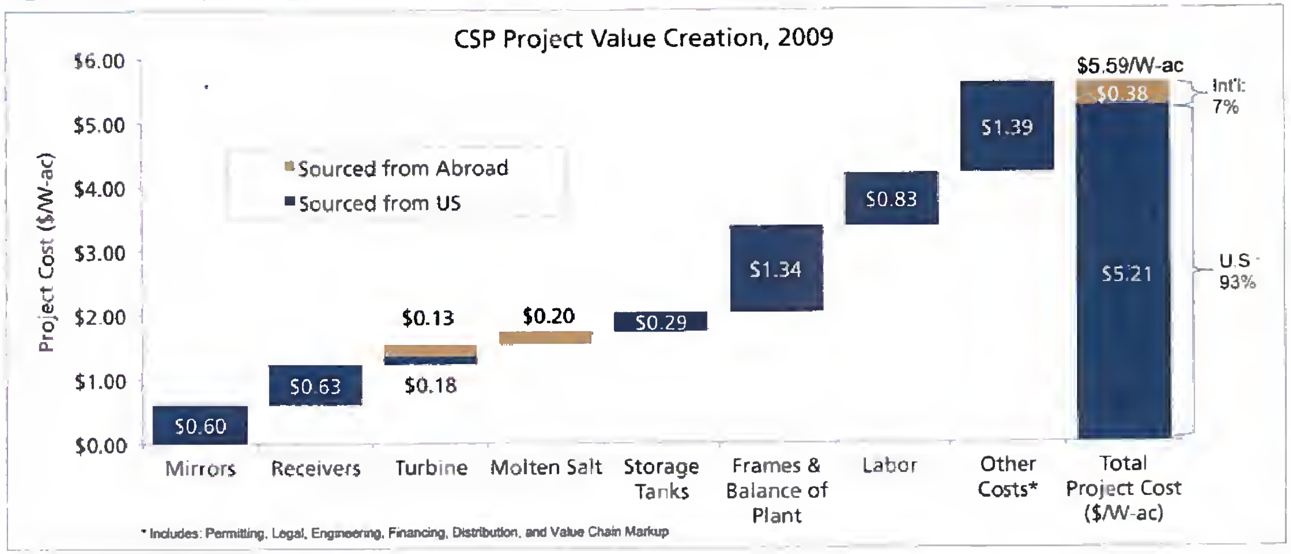
	Total Project Cost ($/W-ac)	% of total cost	% U.S. Sourced	U.S. Content ($/W-ac)	% of total value
Mirrors	$0.60	11%	100%	$0.60	
Receivers	$0.63	11%	100%	$0.63	
Turbine	$0.31	6%	42%	$0.13	
Molten Salt	$0.20	4%	0%	$0.00	
Storage Tanks	$0.29	5%	100%	$0.29	
Frames & Balance of Plant	$1.34	24%	100%	$1.34	
Labor	$0.83	15%	100%	$0.83	
Other Costs	$1.39	25%	100%	$1.39	
Total	$5.59	100%	93%	$5.21	93%

Source: GTM Research

Total system costs of $5.59/W-ac are 93% sourced domestically, which equates to $5.20/W-ac. All CSP costs are shown in cost per watt-ac (alternating current). Whereas PV plants produce direct current (dc) power that needs to be converted to ac, CSP plants produce ac directly. For an apples-to-apples comparison between CSP and PV cost per watt, the PV cost should be multiplied by 1.18 to convert to cost per watt-ac. The cost of $5.59/W-ac is a blend of more expensive systems with storage, and less expensive systems without storage. In the U.S. in 2009, there was $81 million spent on CSP projects (eSolar's Sierra SunTower and Sopogy's Holaniku), of which $76 million in value was retained in the U.S. CSP plants have a higher domestic value

creation percentage than PV, as many of the components for CSP are commodity items and therefore have low value per pound (steel, cement, gravel, mirrors, etc.), therefore making it more economical for CSP plants to use domestic suppliers to avoid transport costs.

Figure 3-4: CSP Project Value Creation, 2009



Source: GTM Research

3.1.1 Mirrors

Mirrors represent 11% of the total cost of a CSP project. In the case of Solana, they plan is to source the mirrors from Rioglass, which has recently announced a plant in Surprise, Arizona. Phase I of the facility is 130,000 square feet, and is expected to be operational by 2011. For Ivanpah, the glass is being provided by several vendors, and then the heliostats are being assembled at the project site. As the mirrors for powers towers can be nearly flat, there are numerous vendors in the U.S. who could serve as suppliers. Because both projects plan to use U.S. suppliers, mirrors are therefore considered to be 100% domestically sourced.

Source: Schott Solar

Source: BrightSource Energy

Source: Geothermal Education Office

3.1.2 Receivers

Glass receiver tubes represent 11% of the total cost of a CSP project. For Solana, the receiver tubes are expected to come from the Schott Solar facility in Albuquerque, NM – which has an annual capacity of 200 MW (which should be sufficient to supply Solana, as the plant will take close to two years to complete). The image on the left depicts a row of Schott receiver tubes mounted above a parabolic trough collector.

For Ivanpah, the receivers are expected to come from RILEYPower (Babcock Power) which is headquartered in Worcester, Massachusetts. Receivers are therefore considered to be 100% domestically sourced. An image of the central tower receiver is pictured below.

3.1.3 Turbine

The steam turbine generator comprises 6% of the total cost for a CSP plant. For Solana, the turbine manufacturer has not yet been finalized, but it is expected that it will be manufactured in the U.S. For Ivanpah, the turbine will be provided by Siemens, which is headquartered in Germany. As a steam turbine is an incredibly large and heavy piece of equipment, it is very likely that portions of the turbine will be manufactured and assembled in the U.S. Nonetheless, for the analysis, it was assumed that the Ivanpah turbine is sourced from abroad. Turbines are therefore considered to be 42% domestically sourced. A diagram of the major elements in a steam turbine is pictured on the left.

3.1.4 Molten Salt

Molten salt represents 4% of the total cost of a CSP plant. It is a mixture of 60% sodium nitrate and 40% potassium nitrate (saltpeter), and is used for thermal energy storage. For Solana, the molten salt will likely be sourced from Chile (90% of all imported sodium nitrate and potassium nitrate comes from Chile). For Ivanpah, there is no storage, and therefore no molten salt required. Accordingly, molten salt is considered to be 0% domestically sourced.

Source: ACS-Grupo Cobra

3.1.5 Storage Tanks

Storage tanks represent 5% of the total cost of a CSP plant. Shipping costs should make it more economical to source large, heavy tanks from the U.S. than abroad. Therefore, they are considered to be 100% domestically sourced. Pictured to the left are the molten salt storage tanks at the Andasol plant in Spain.

Source: Hydro Aluminum and Gossamer Space Frames

3.1.6 Frames and Balance of Plant

The frames and bases for parabolic troughs and heliostats are largely made from steel and concrete (cement, gravel, rock, and sand). All of these materials can be economically sourced domestically, and Abengoa announced that it plans to do so for Solana. It is likely that Ivanpah will also use local inputs for steel and concrete as transport costs for imported goods would be prohibitively high. Therefore, they are considered to be 100% domestically sourced. The frame for a parabolic trough system is pictured below.

3.1.7 Labor

Labor is considered to be 100% domestically sourced.

3.1.8 Other Costs and Value Chain Markup

As with PV, other costs include:

- Site preparation
- Permitting fees
- Project management costs
- Sales and property taxes
- Land
- Insurance
- System design, engineering, and architectural costs
- Interconnection fees
- Public relations, legal fees and environmental mitigation
- Finance related (debt reserve, lender fees)

All of these tasks are typically performed by U.S. companies or U.S. subsidiaries of foreign companies. Site preparation is defined as any logistical and physical preparation, coordination and work that must be performed to install a system at the site. This includes civil, structural or electrical infrastructure improvements, and transporting materials on-site.

Value chain markup includes overhead and profit margins captured in the period between equipment manufacturing and final installation. Installed materials often undergo markups by both the distributor and the engineering, procurement and construction firm (EPC). The combination of other costs and value chain markup represents 25% of total system costs.

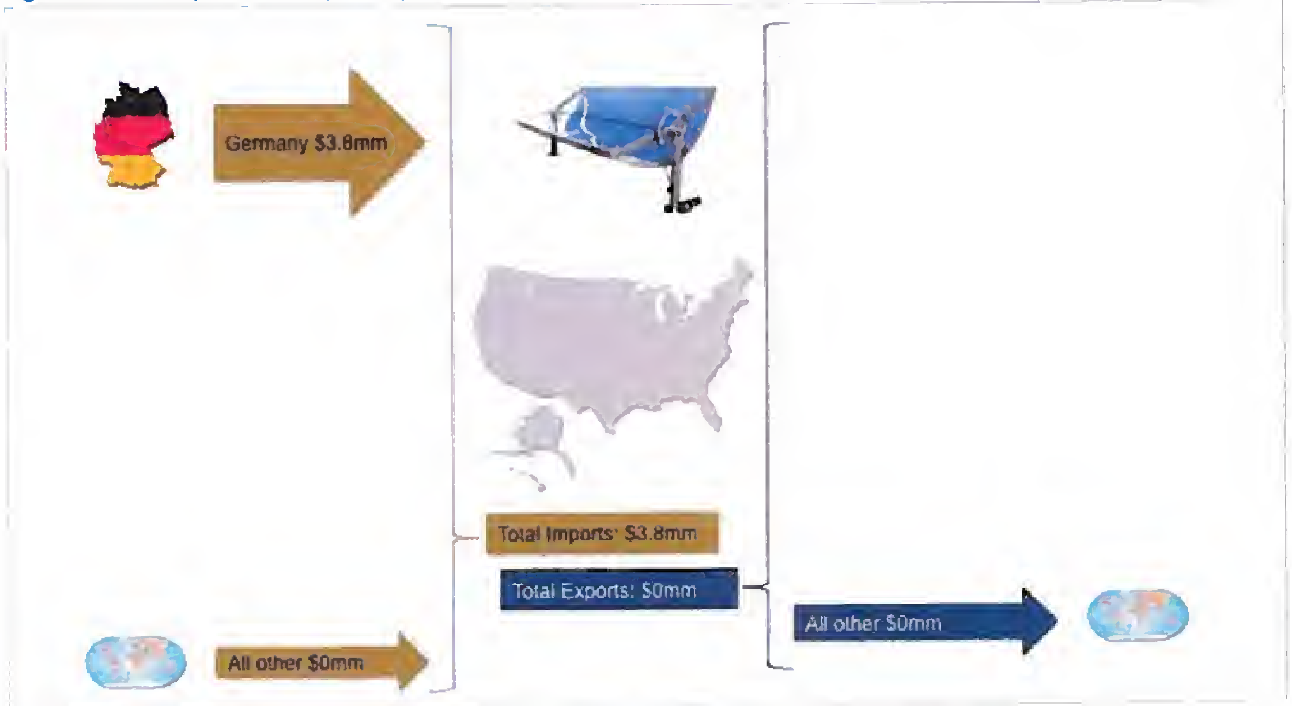
Other costs and value chain markup costs were calculated by a top-down methodology by taking the total project cost less the known component costs (mirrors, receivers, turbine, etc.).

Other costs and value chain markup are considered to be 100% domestic.

3.2 CSP Trade Flow Analysis

In 2009, the U.S. did not export any components for CSP projects in the rest of the world. The U.S. did import mirrors for the Holaniku project from Alanod Aluminium-Veredlung in Germany. The effective value of the imports was estimated at $3.8 million. Overall, the dollar flows are miniscule compared to the trade flows from PV.

Figure 3-5: CSP Imports and Exports by Source/Destination, 2009



Source: GTM Research

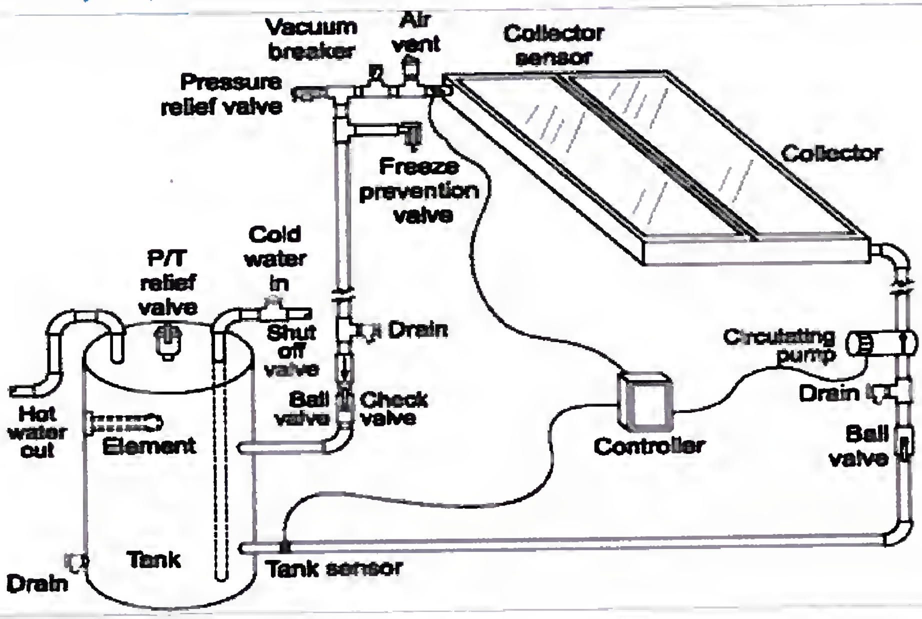
4 SOLAR HEATING & COOLING

4.1 Solar Water Heating (SWH)

4.1.1 Domestic Value Created

Solar Water Heating systems are most commonly medium temperature collectors that are used to heat domestic hot water. The system is composed of three main parts: collectors, storage tank, and all other equipment (controller, pump, valves, etc.).

Figure 4-1: Diagram of the Primary Components of a SWH System



Source: Missouri Department of Natural Resources

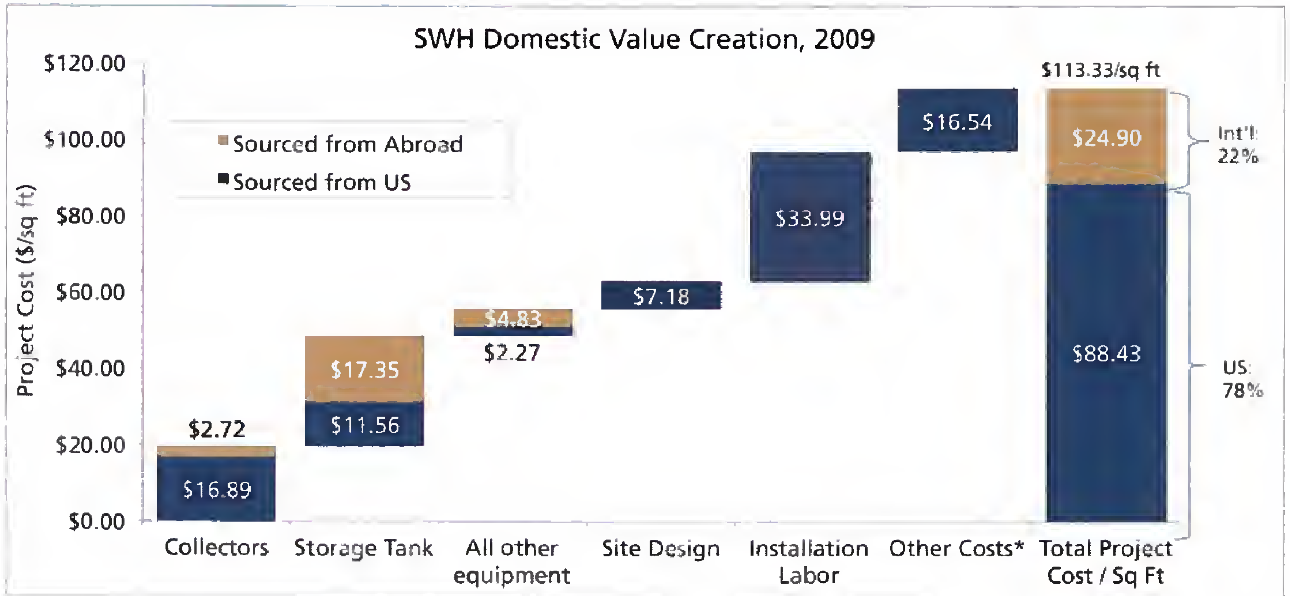
Figure 4-2: SWH Percent of Value Created in the U.S.

	U.S. $/SQ FT	AVERAGE SYSTEM COST	% OF TOTAL	ASSUMPTION FOR % OF SWH INSTALLED USING U.S. COMPONENT	DOMESTIC VALUE CREATED/ SQ FT	% OF TOTAL
Collectors	$19.61	$1,243	17%	86%	$16.89	
Storage Tank	$28.91	$1,833	26%	40%	$11.56	
All other equipment (controller, valves, pump, sensor, reservoir, expansion tank)	$7.10	$450	6%	32%	$2.27	
Site Design	$7.18	$455	6%	100%	$7.18	
Installation Labor	$33.99	$2,154	30%	100%	$33.99	
Other Costs	$16.54	$1,049	15%	100%	$16.54	
Total	**$113.33**	**$7,184**	**100%**		**$88.43**	**78%**
Total Systems Installed in 2009	41,324					
Sq Ft Per System (based on 1H2010)	63.4					
Sq Ft installed in 2009	2,619,631					
Total Value Creation for U.S. Companies	$231,654,638					
Total Value Creation for Foreign Companies	$65,228,177					
Total	$296,882,815					

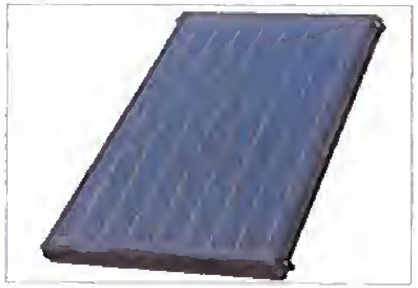
Source: GTM Research

SWH total system costs of $113/sq ft are 78% sourced domestically, which equates to $88/sq ft. In the U.S. in 2009, there was $297 million spent on SWH installations. With 78% of the value being retained in the U.S., that equates to $232 million.

Figure 4-3: SWH Domestic Value Creation, 2009



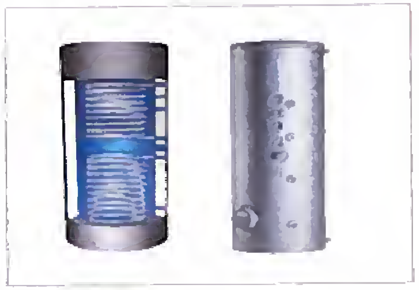
Source: GTM Research



Source: Solar Panels Plus

4.1.1.1. SWH Collectors

Collector price per square foot is based on EIA data for medium-temperature collectors (ICS/thermosiphon, flat plate, and evacuated tube). The price is a factory-gate price and excludes the distributor/wholesaler markup. The percent of collectors that are domestically sourced is 86%. This is calculated by dividing the $44.2 million of U.S.-made collectors installed in the U.S. by the $51.4 million of total collectors installed in the U.S. in 2009.



Source: TISUN

4.1.1.2. Storage Tank

Storage tanks represent 26% of the total cost of a SWH system, or around $1,800 for a blended system (mix of open and closed loop, mix of residential and non-residential). Storage tank price is based on data from state rebate agencies which provide system cost breakdowns. The price is a blend of one and two tank systems, and stainless and non-stainless tanks. Based on a survey of solar water heating tank manufacturers, it was estimated that 40% of tanks are sourced domestically. A significant percentage of the tanks are assembled in Mexico and shipped to the U.S.

Source: Thermo Technologies

4.1.1.3. All Other Equipment

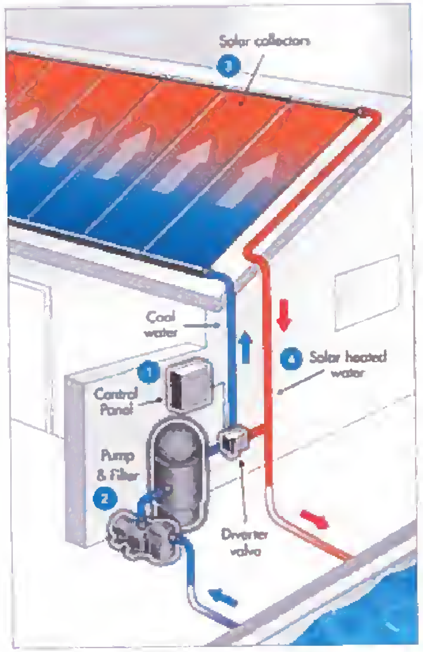
All other equipment includes:

- Controller
- Valves
- Pump
- Sensor
- Reservoir
- Expansion tank

Costs were based on published online pricing, and works out to $450 per system -- or 6% of total system cost. The percent sourced domestically was based on conversations with pump and controller manufacturers, and was estimated at 32%.

4.1.1.4. Site Design and Installation Labor

Costs were based on installation data sourced from state rebate agencies. They represent 36% of the total system cost, or a blended cost of around $2,600 per installation (residential and non-residential). Costs were considered to be 100% domestic.



Source: Abacus Energy Partners

4.2 Solar Pool Heating (SPH)

4.2.1 Domestic Value Created

Solar Pool Heating systems are relatively simple systems with two main parts: collectors, and all other equipment (including pump, valves, and the controller). A diagram of a typical solar pool heating system is pictured below.

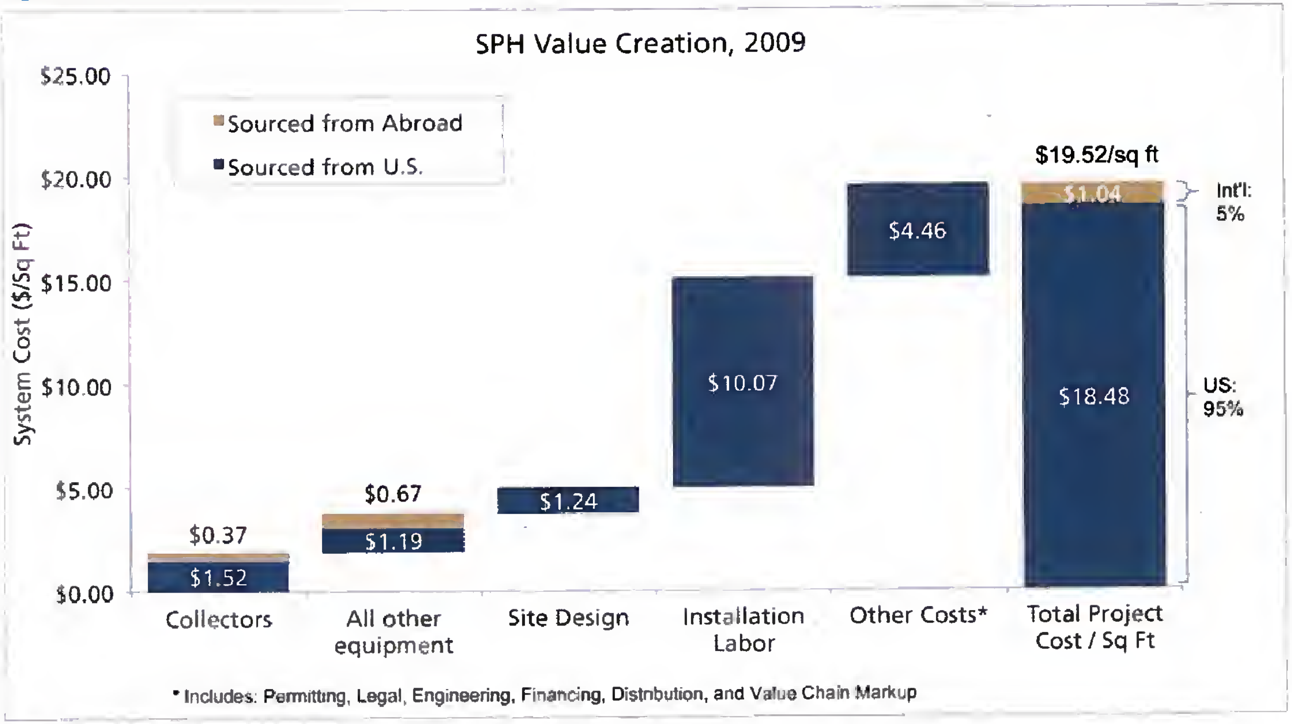
SPH total system costs of $19.52/sq ft are 95% sourced domestically, which equates to $18.48/sq ft. In the U.S. in 2009, there was $210 million spent on SPH installations. With 95% of the value being retained in the U.S., that equates to $199 million.

Figure 4-4: SPH Percent of Value Created in the U.S., 2009

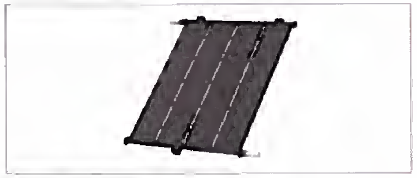
	$/SQ FT	% OF TOTAL	AVERAGE SYSTEM COST	U.S. MARKET SHARE OF WORLDWIDE MANUFACTURING	ASSUMPTION FOR % OF SWH INSTALLED USING U.S. COMPONENT	DOMESTIC VALUE CREATED/ SQ FT	% OF TOTAL
Collectors	$1.89	10%	$630	33%	81%	$1.52	
All other equipment (controller, etc.)	$1.86	10%	$620	50%	64%	$1.19	
Site Design	$1.24	6%	$412	100%	100%	$1.24	
Installation Labor	$10.07	52%	$3,359	100%	100%	$10.07	
Other Costs	$4.46	23%	$1,487	100%	100%	$4.46	
Total	**$19.52**	**100%**	**$6,510**			**$18.48**	**95%**
Total Systems Installed in 2009	32,311						
Sq Ft Per System (based on 1H2010)	333.5						
Sq Ft Installed in 2009	10,775,801						
Total Value Created for U.S. companies	$199,172,207						
Total Value Created for Foreign Companies	$11,171,424						
Total	**210,343,632**						

Source: GTM Research

Figure 4-5: SPH Value Creation, 2009



Source: GTM Research



Source: Pool Solar Panels

4.2.1.1. SPH Collectors

Collector price per square foot is based on the EIA data for low-temperature collectors. The price is a factory-gate price and excludes the distributor/wholesaler markup. The percent of collectors that are domestically sourced is 81%. This is calculated by dividing the $16.4 million of U.S.-made collectors installed in the U.S. by the $20.4 million of total collectors installed in the U.S. in 2009. Collectors represent 10% of the total system cost.

4.2.1.2 Other Equipment

Other equipment cost is based on typical pricing for a residential system and includes the pump, valves, and controller. The 64% domestic content is based on conversations with leading controller and pump manufacturers. All other equipment is estimated at $620 for an average blended (residential and non-residential) system – which works out to 10% of the total system cost.

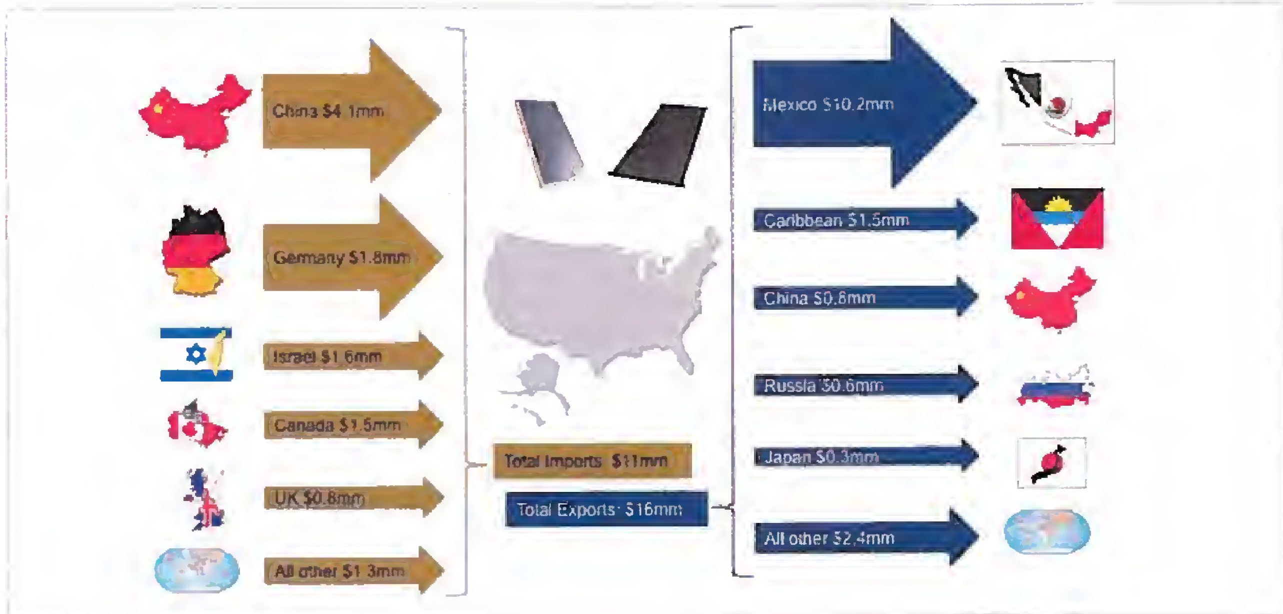
4.2.1.3 Site Design and Installation Labor

Site design costs were based on the percentage of total installation cost for a SWH system (which was derived from installation data from state rebate agencies). Combined, site design and installation labor comprise 58% of the total system cost.

4.3 SWH and SPH Trade Flow Analysis

The U.S. imported $11 million of SWH and SPH collectors, with evacuated tube SWH collectors coming from China, flat plate SWH collectors coming from Germany, and unglazed plastic SPH collectors from Israel. The U.S. exported $16 million of SWH and SPH collectors, primarily unglazed plastic SPH collectors to Mexico. That equates to a trade balance of $4.7 million, with the U.S. as a net exporter of SWH and SPH collectors.

Figure 4-6: SWH and SPH Imports and Exports by Source/Destination, 2009

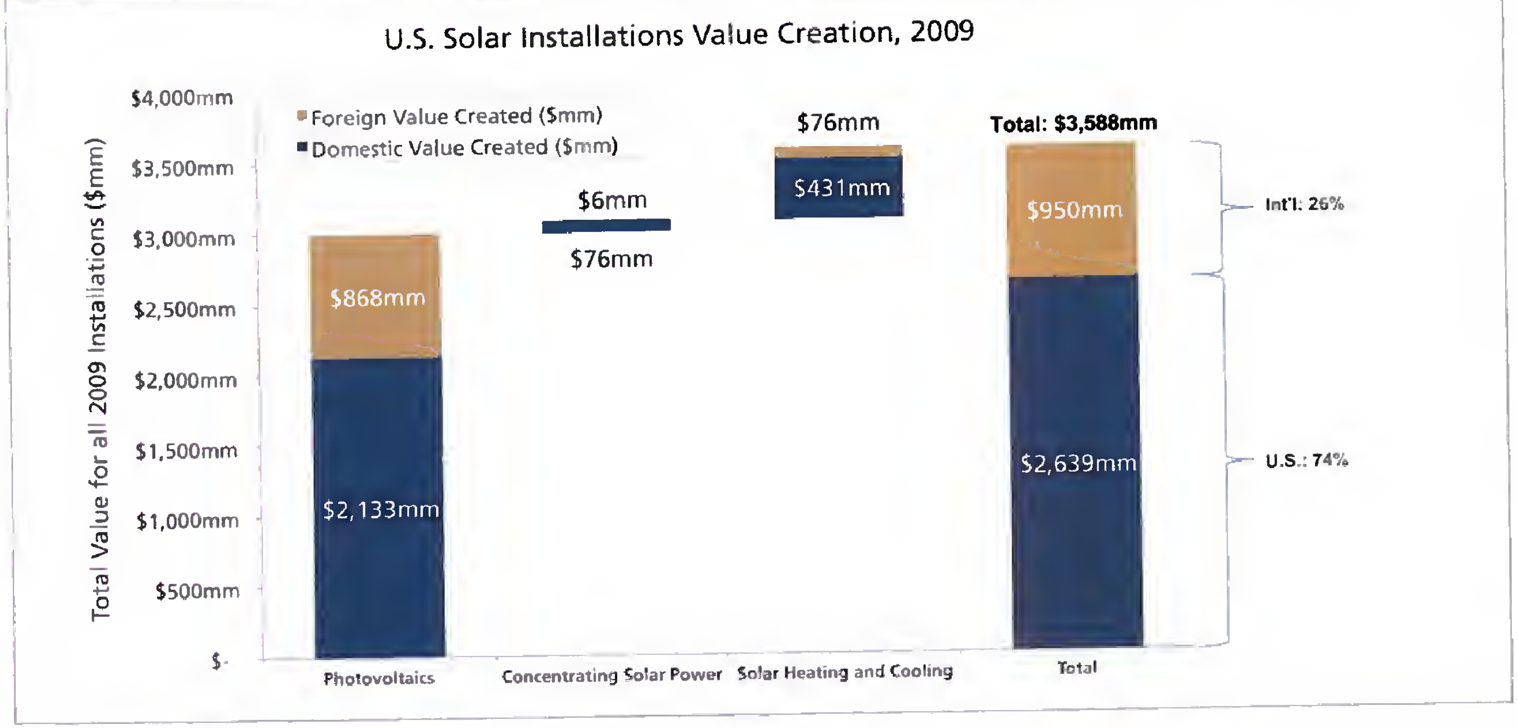


Source: GTM Research

5 AGGREGATE FINDINGS

The figure below details total and domestic value creation for all solar energy-related goods and services in 2009, created by summing all the analysis conducted in previous sections. In total, $3.6 billion of value was created in the U.S., of which $2.7 billion, or 74%, was sourced domestically. PV clearly constituted the majority of domestic sourcing, at $2.1 billion, with non-module costs playing a material role in the outcome. At the same time, almost all of the value created from foreign sources also came from PV, primarily in the area of module manufacturing.

Figure 5-1: Solar Installations Value Creation, 2009



Source: GTM Research

Aggregating trade flows for all solar energy segments for 2009 yields a total export figure of $2.3 billion, while imports sum up to $1.6 billion. Net exports, therefore, totaled $723 million for 2009. The bulk of this, as indicated below, comes from polysilicon, where the U.S. has a strong manufacturing presence. While module exports to Germany and Japan amounted to $1.0 billion in revenue, they were offset by imports of $1.2 billion from lower-cost locations such as China and Mexico.

Figure 5-2: Solar Industry Trade Flows, 2009

Source: GTM Research, International Trade Commission

APPENDIX A: METHODOLOGY

TECHNOLOGY	COMPONENT	METHODOLOGY FOR DETERMINING U.S. DOMESTIC VALUE CREATION
PV	Polysilicon	• The percentage of value created domestically by polysilicon in a U.S.-installed system was estimated based on U.S. share of global polysilicon production.
	Wafer	• As with polysilicon, the percentage of value created domestically by wafers in a U.S.-installed system was estimated based on U.S. share of global production.
	Cell	• The analysis is concerned with c-Si cells present in domestically assembled modules; these could have been assembled either in the U.S. itself or abroad. The percentage of domestic value created in the c-Si cells that were used in modules assembled domestically versus abroad are considered separately, and then blended together on a weighted average basis. • Data from GTM Research indicates that 256 MW of crystalline silicon modules were both assembled and installed in the U.S. in 2009. Each of these modules required an equivalent amount of cells for its assembly, obtained either from domestic cell production, or through imports. • U.S. International Trade Commission data was obtained for the total dollar value and number of cells imported. Using this, total crystalline silicon cell imports in 2009 were estimated at 79 MW. Based on this, 78% of the value of c-Si cells present in modules both installed and assembled domestically was sourced from the U.S. • For U.S.-installed modules assembled abroad, value created domestically was estimated based on U.S. share of global c-Si cell production, which was 3% as discussed above. • The overall percentage of value created domestically by U.S.-installed crystalline silicon cells was estimated as a weighted average of that for (i) U.S. installed modules that were produced domestically and (ii) U.S.-installed modules that were produced abroad. To determine the weights (i.e. what fraction of U.S.-installed crystalline silicon modules were assembled domestically vs. abroad), data for domestically installed crystalline silicon modules was examined for residential and commercial projects in California and New Jersey (which list installations by module manufacturer) and for utility-scale installations nationwide; this was extrapolated to be representative of national values. It was determined that of the 366 MW of c-Si modules assembled in the U.S. in 2009, 105 MW, or 29%, were assembled domestically. Thus, the final percentage of value created for cells was calculated as (78%*29% + 3%*(1-29%)) = 25%.

PV	Crystalline Module	• Module manufacturer-specific data from residential and commercial systems from California and New Jersey, as well as national utility-scale installation data was examined to calculate what percentage of U.S. installations used modules from domestic manufacturers. In the case where the manufacturer had facilities in both the U.S. and abroad, it was assumed that the module was produced by the U.S.-based facility.
	Thin Film Module	• To determine the percentage of value created domestically for a thin film installation, each of the cost components above was examined individually. A conservative fraction of domestic contribution was then assigned to each, based on the specifics of the CdTe vendor in question. As shown below, it is assumed that 100% of the labor, utilities, and overhead are domestic in nature: this is because the CdTe vendor that made up 95% of thin film installations in 2009 has a factory in the U.S. whose output is many times its U.S. share, and it was therefore assumed that the modules installed in the U.S. were also produced in the U.S. Capital equipment and glass are assumed to be sourced 80% domestically, while the cadmium telluride feedstock, encapsulant, junction box, and cable were all assumed to be sourced 100% from abroad. These assumptions are believed to be conservative given a lack of public disclosure; it is highly likely that a significant proportion of these goods was sourced domestically.
	Blended PV Module	• To estimate the overall percentage of value created domestically in U.S.-installed crystalline silicon modules, one simply needs to attach the proportions of the individual value chain segments (polysilicon, wafer, cell, module) determined above to their contribution to the overall module cost structure. Here, the markup (or profit) for each segment must also be included, as it contributes to the overall cost of the system. The percentage of value created domestically for the markup is assumed to be identical to that of the relevant component; so if 40% of the polysilicon content is created domestically, for example, the polysilicon markup is also assumed to be 40% domestically sourced.
	Inverter	• Market shares for inverter manufacturers were determined by utilizing public data available on technology used in installations in 2009 . • Values were assigned based on average factory-gate prices by market segment. • For companies with only foreign-based manufacturing, 100% of value was assigned to foreign manufacturing. • For companies with both U.S. and foreign production capacity, non-exported omestic production was exhausted before using foreign production on a per-market-segment basis.
	Mounting Structure	• Average mounting structure costs were determined through conversations with major mounting structure manufacturers and real project costs breakdowns from PV installers. • Manufacturing and assembly location was determined through conversations with major mounting structure manufacturers. • Greater weight was placed on rooftop mounting solutions than ground-mount solutions because the U.S. was dominated by rooftop systems in 2009.

PV	Combiner Box and Misc. Electrical	• Balance of systems equipment costs were determined by real project cost breakdowns from installers and integrators. • Conversations with major suppliers of combiner boxes were used to determine origination of combiner box manufacturing and assembly. • Imports and exports of relevant commodity hardware were sourced from the U.S. International Trade Commission. • Use of electrical equipment is assumed to mimic international trade flows, and thus domestic value is equivalent to the ratio of domestically-sourced exports to total trade volume.
	Other Costs	• Site preparation, labor, soft costs and value chain markup costs were calculated by a top-down methodology from total average system price less material and component costs. • Further breakdown between site preparation and labor costs versus soft costs and value chain markup were based on sample project cost breakdowns obtained from PV installers, published materials from Lawrence Berkeley National Laboratory and public data available from the New York state solar rebate program.
	Crystalline Silicon Systems	• Total crystalline silicon PV system costs were collected from state and utility rebate programs with known thin film projects removed. • Systems costs beyond two standard deviations from the average cost-per-watt were removed. • Capacity weighted average pricing was determined by dividing all remaining system costs by total remaining installed capacity. • Further guidance was given from Lawrence Berkeley National Laboratory and real project system breakdowns provided by installers. • Crystalline module costs as determined above were used for module costs. • All other system category costs and domestic value percentage use the same methodology as described above.
	Thin Film Systems	• Information from the U.S. Department of The Treasury, published costs and equipment usage were used to estimate project costs for a 25 MW thin film system installed in 2009. • This value is blended with estimated costs for a rooftop thin film system, accounting for additional balance of systems cost resulting from a lower efficiency point; in step with industry convention, 6% additional BOS costs for every 1% difference in module efficiency was estimated. • Unless otherwise known, domestic value creation for each component was assumed to be the same as calculated for the overall industry.
	Blended PV Systems	• PV system costs were collected from state and utility rebate programss. • Systems costs beyond two standard deviations from the average cost-per-watt were removed. • Capacity weighted average pricing was determined by dividing all remaining system costs by total remaining installed capacity. • Estimated thin film system costs and capacities were blended with the above in proportion to installed capacity in 2009. • Further guidance was given from Lawrence Berkeley National Laboratory and real project system breakdowns provided by installers.

CSP	All components	• Conversations with the primary developers regarding sourcing and suppliers.
	Total System Cost	• Based on publically available data on Ivanpah and Solana. • The aggregate cost is a weighted average of the two projects based on gross capacity. • The cost breakdown by component is based on the 2009 UC Berkeley study on CSP.
SWH	Collectors	• The collector pricing was based on the EIA 2008 data for medium temperature collectors. • Percent sourced domestically is based on the following calculation: total U.S. manufactured collectors installed in the U.S. divided by the total installations in the U.S. (which includes imported collectors).
	Tanks	• Storage tank price is based on data from state rebate agencies which provide system cost breakdowns. The price is a blend of one and two tank systems, and stainless and non-stainless tanks. • The percent of tanks sourced domestically is based on a survey of solar water heating tank manufacturers.
	All other equipment	• Price is based on data from state rebate agencies which provide system cost breakdowns. • The percent sourced domestically was based on conversations with pump and controller manufacturers.
	System Cost	• The total system cost came from installer data and state rebate agency data as published in the SEIA/GTM Research Solar Market Insight report.
SPH	Collectors	• The collector pricing was based on the EIA 2008 data for low temperature collectors. • Percent sourced domestically is based on the following calculation: total U.S. manufactured collectors installed in the U.S. divided by the total installations in the U.S. (which includes imported collectors).
	All other equipment	• Other equipment cost is based on typical system pricing and includes the pump, valves, and controller. • Domestic content percentage is based on conversations with leading controller and pump manufacturers.
	System Cost	• The total system cost came from installer data and state rebate agency data as published in the SEIA/GTM Research Solar Market Insight report.

APPENDIX B: SOURCES

Sources for Domestic Value Creation Analysis

TECHNOLOGY	COMPONENT	SOURCES
PV	Polysilicon	· GTM Research proprietary manufacturing database · Conversations with manufacturers
	Wafer	· GTM Research proprietary manufacturing database · Quarterly earnings statements from publicly traded companies · Conversations with manufacturers
	Cell	· GTM Research proprietary manufacturing database · Quarterly earnings statements from publicly traded companies · Conversations with manufacturers · Department of Commerce / U.S. International Trade Commission data for 2009 · State and utility solar rebate programs (California, New Jersey)
	Crystalline Module	· GTM Research proprietary manufacturing database · Quarterly earnings statements from publicly traded companies · Conversations with manufacturers · Public announcements and reporting for major U.S. projects · Department of Commerce / U.S. International Trade Commission data for 2009 · State and utility solar rebate programs (California, New Jersey)
	Thin Film Module	· GTM Research proprietary manufacturing database · Quarterly earnings statements from publicly traded companies; specifically, gross margin (markup) for thin film modules were obtained from First Solar's quarterly and annual financial statements, available at http://investor.firstsolar.com/phoenix.zhtml?c=201491&p=irol-irhome. · Conversations with manufacturers · Public announcements and reporting for major U.S. projects · Department of Commerce / U.S. International Trade Commission data for 2009 · State and utility solar rebate programs (California, New Jersey)
	Inverter	· State solar rebate programs (California, New Jersey) · Quarterly earnings statements from publicly traded companies · Conversations with manufacturers, · Public announcements and reporting for major U.S. projects

PV	Mounting	· Conversations with major suppliers of mounting structure solutions
	Combiner Box and Misc Electrical	· Conversations and sample project breakdowns from installers · Channel checks with combiner box suppliers · Department of Commerce / U.S. International Trade Commission data for 2009 (for conductors, metal conduits, vinylchloride tubing, fuses, circuit breakers, switches, and enclosures)
	Other Costs	· Sample project cost breakdowns from PV installers · Lawrence Berkeley National Laboratory · New York State solar rebate programs
	Crystalline Silicon System Costs	· State and utility solar rebate programs (California, New Jersey, Arizona, Florida, Massachusetts) · NREL OpenPV · Lawrence Berkeley National Laboratory · Sample cost breakdowns from PV installers · Public announcements and reporting for major U.S. projects
	Thin Film System Costs	· Department of The Treasury · Public announcements and reporting for major U.S. projects
	Blended PV Costs	· State and utility solar rebate programs (California, New Jersey, Arizona, Florida, Massachusetts) · NREL OpenPV · Lawrence Berkeley National Laboratory · Sample cost breakdowns from PV installers · Public announcements and reporting for major U.S. projects
CSP		· Conversations with developers, system manufacturers, and suppliers · System manufacturers' websites and press releases · "Concentrating Solar Power" by Russell Muren and Eric Gimon, UC Berkeley (2009) · Department of Commerce / U.S. International Trade Commission data for 2009
SWH		· SEIA/GTM Research Solar Market Insight 2Q 2010 · U.S. EIA data from 2008 · SWH installation data from CT state rebate program · Department of Commerce / U.S. International Trade Commission data for 2009 · Conversations with component manufacturers

SPH		· SEIA/GTM Research Solar Market Insight 2Q 2010 · U.S. EIA data from 2008 · Department of Commerce / U.S. International Trade Commission data for 2009 · Conversations with component manufacturers

Sources for Trade Flow Analysis

TECHNOLOGY	COMPONENT	SOURCES
PV	Polysilicon	· GTM Research proprietary manufacturing database · Conversations with manufacturers · Department of Commerce / U.S. International Trade Commission data for 2009
	Wafer	· GTM Research proprietary manufacturing database · Conversations with manufacturers
	Cell	· Department of Commerce / U.S. International Trade Commission data for 2009
	Module	· Department of Commerce / U.S. International Trade Commission data for 2009
	Inverter	· Quarterly earnings statements from publicly traded companies · Conversations with manufacturers · Public announcements and reporting for major U.S. projects
CSP	Mirrors	· Conversations with manufacturers
	Receivers	· Conversations with manufacturers
SWH	Collectors	· Department of Commerce / U.S. International Trade Commission data for 2009
SPH	Collectors	· Department of Commerce / U.S. International Trade Commission data for 2009

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